

Educating for a sustainable future? – Perceptions of bioeconomy among forestry students in Sweden

*Utbildning för en hållbar framtid? – Svenska skogsstudenters
uppfattningar av bioekonomi*

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Summary

Unsustainable consumption has led to the crossing of several planetary boundaries, which is threatening life on this planet as we know it. To be able to cope with this challenge, CE, *Circular Economy*, has been introduced as a way forward. Additionally, often seen as a subcategory of CE, *bioeconomy* is a frequently used word in the sustainability debate. It is a concept associated with using renewable, bio-based resources. However, scientists still stand without a common definition of the concept.

Looking at Sweden, the biggest natural and renewable resource is the forest, and it therefore plays an important part in the Swedish bioeconomy. Due to the magnitude to which the forest is a resource in the country, there are several vocational programmes for forest management offered at higher educational level. SLU, the Swedish University of Agricultural Sciences, offer two of these programmes from bachelor level; the forestry bachelor program and the forestry master programmes. Furthermore, these programmes are pledged to weave the goals of Agenda 2030 into the course curricula and pedagogy. Agenda 2030 was created by the UN, United Nations and contains several Sustainable Development Goals, SDG's, to further accelerate sustainable change. Several of these goals can be linked to the Swedish forest sector, and goal 4.7 and 15.2 have a direct connection with forestry programmes at SLU. SDG 4.7 states that *all learners should acquire the knowledge needed to promote sustainable development*, and SDG 15.2 claims that *implementation of sustainable forests management should be promoted*. Based on these goals, as well as on seeing these forestry students as future stakeholders in the national, forest-based bioeconomy, how these students perceive the concept of bioeconomy becomes important. This is due to that bioeconomy will continue to grow as a field in the sustainability debate. Moreover, how the students perceive the *forest's role* in the national bioeconomy, as well as their *education* on the topic, are of interest to investigate.

To answer these questions, and to get an overview of the students' perceptions of bioeconomy, a survey by the research team PerForm, Perceiving the Forest-based Bioeconomy, was created. It was carried out on all campuses at SLU which offers forestry education, where students could fill in the questions with the thesis writer *in situ*. The questions with fixed alternatives for answers were presented in the form of descriptive statistics, and a thematic coding analysis was used to analyse the open-ended survey questions. The analysis was built on theory regarding the SD, sustainable development, competencies needed to solve sustainability issues that should be acquired at higher education institutes.

The findings indicate that the students have heard of bioeconomy, although they are not in unison when it comes to what the concept means. They further express that the forest is Sweden's most important bioeconomy resource. Additionally, they are not content with the extent to which bioeconomy has been addressed during their education and ask for more fully developed education on the subject. Furthermore, looking at the curriculums, SLU has successfully implemented several of the sustainable development, SD, competencies necessary for achieving SDG's 4.7 and 15.2. These competencies are moreover indicated in the student responses as well. However, further studies are needed to see how the students apply these competencies to sustainability problems.

Key words: *circular economy, forest education, higher education for sustainable development, PerForm, survey study*

Sammanfattning

Livet på denna planet hotas av ohållbar konsumtion, vilket redan har lett till att flera planetära gränser överskridits. För att hantera utmaningen som konsumtionssamhället skapat har CE, Circular Economy, introducerats som ett alternativ till den mer linjära modell vi ser idag. Vidare har *bioekonomi* blivit ett ofta omnämnt ord i hållbarhetsdebatten, då det kan ses som en gren av CE. Begreppet associeras med användning av förnyelsebara, bio-baserade resurser, dock står dagens forskare fortfarande utan en gemensam definition för ordet.

Skogen spelar en viktig roll i den svenska bioekonomin, då den utgör nationens största förnyelsebara resurs. Att skogen är en så viktig nationell resurs har lett till att flera skogliga, yrkesförberedande program på högre utbildningsnivå har skapats. SLU, Sveriges Lantbruksuniversitet, erbjuder två av dessa från grundläggande nivå; jägmästarprogrammet och skogsmästarprogrammet. Dessa program influeras av hållbarhetsmålen från Agenda 2030 från FN, Förenta Nationerna, då universitetet har åtagit sig att implementera Agenda 2030 i sin verksamhet. Flera av hållbarhetsmålen kan kopplas till den svenska skogsindustrin, och mål 4.7 och 15.2 är direkt kopplade till den skogliga utbildningen vid SLU. Mål 4.7 förkunnar att *alla studerande bör få tillräcklig kunskap för att kunna verka för hållbar utveckling*, och mål 15.2 yrkar på att *implementeringen av hållbart skogsbruk bör gynnas*. Med dessa mål som grund är det viktigt att förstå hur de svenska skogsstudenterna uppfattar bioekonomi, då de kommer att utgöra intressenter i den skogligt-baserade bioekonomin framöver, en gren av bioekonomin som kommer troligen kommer att fortsätta växa som en del i hållbarhetsdebatten. Dessutom blir det viktigt att undersöka hur studenterna uppfattar *skogens roll* i den nationella bioekonomin, samt deras åsikter om hur deras *utbildning rörande bioekonomi* genomförs i dagsläget.

För att besvara frågorna ovan skapades en enkät av den internationella forskargruppen PerForm, Perceiving the Forest-based Bioeconomy. Den genomfördes vid alla de campus vid SLU som erbjuder skoglig utbildning, och studenterna kunde få hjälp på plats av författaren till denna uppsats. Frågorna med förbestämda svarsalternativ presenterades i form av deskriptiv statistik. De öppna frågorna analyserades med hjälp av tematisk kodning. Datan från båda typer av frågor jämfördes sedan med teori rörande de hållbarhetskompetenser studenter vid institutioner för högre utbildning bör utveckla för att kunna lösa hållbarhetsproblem.

Resultatet indikerar att studenterna har hört talats om bioekonomi men är något osäkra på vad begreppet innebär. Vidare anser de att skogen är Sveriges viktigaste bioekonomiska resurs. De är dessutom missnöjda med hur (lite) bioekonomi har tagits upp under utbildningen hittills, och efterfrågar utförligare utbildning i ämnet. Hållbarhetsmål 4.7 och 15.2 indikerades ha implementerats i utbildningskraven för skogsprogrammen, och flera viktiga hållbarhetskompetenser kopplade till dessa mål kunde ses i studenternas svar. Däremot behövs vidare studier för att se ifall studenterna kan använda dessa kompetenser när de stöter på hållbarhetsproblem.

Nyckelord: *bioekonomi, hållbar utveckling, jägmästare, skogsmästare, SLU, studenter*

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“All the world's a stage, and all the men and women merely players: they have their exits and their entrances; and one man in his time plays many parts, his acts being seven ages”

William Shakespeare

Abbreviations

Abbreviation	Explanation	Page
CE	Circular Economy	1
CP	Critical Pedagogy	8
CSR	Corporate Social Responsibility	22
EC	European Commission	22
EFI	European Forest Institute	22
EfS	Education for Sustainability	8
ENGO's	Environmental Non- Governmental Organisations	3
ESD	Education for Sustainable Development	2
EU	European Union	21
GDP	Gross Domestic Product	23
GDPR	General Data Protection Regulation	20
HE	Higher Education	2
HESD	Higher Education for Sustainable Development	2
NGO	Non-Governmental Organisation	7
PerForm	Perceiving the Forest-based Bioeconomy	9
SD	Sustainable Development	2
SDG's	Sustainable Development Goals	1
SLU	Swedish University of Agricultural Sciences	3
SSNC	Swedish Society for Nature Conservation	6
TBL	Triple Bottom Line	2
TESAF	University of Padova	15
UN	United Nations	1
UNFCCC	United Nations Framework Convention on Climate Change	1

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1 Introduction

This chapter describes the problem of unsustainability, with bioeconomy as a possible solution. Additionally, it highlights education as an important tool for implementing bioeconomy in the real world. Finally, this papers' research questions are presented, which are based on this background.

1.1 Problem background

Due to behavioural and institutional structures in the global society, our resource use has become unsustainable (Hirschnitz-Gabers *et al.*, 2016), and at the end of last decade, three out of nine planetary boundaries had already been crossed (Rockström *et al.*, 2009). This phenomenon is a major threat to our continued existence on this planet, since we already use more resources than the planet can bear to provide us with (Moore *et al.*, 2012). In fact, if we do not change our way of life, by 2030 our demand will be two times the size of Earths' biocapacity (*ibid.*).

One way to decrease this unsustainable consumption pattern is to introduce a circular economy, **CE** (Esposito *et al.*, 2018). CE focuses, in contrast to more linear models, on maximising usage of all resources in every step of a product's lifecycle. However, CE has in many areas yet to take the leap from theory to practise, a step the private sector and world governments are responsible for initiating. A reason for this delay could be that there is no consensus on a set definition of CE, and therefore CE is difficult to implement (*ibid.*).

In a CE, the origin of the resources is crucial, since these resources need to be renewable and possible to circulate in a financially liable way (Mishra *et al.*, 2018), a challenge which bioeconomy is a possible solution to (McCormick & Kautto, 2013). Skånberg *et al.* (2016) define bioeconomy as a *sector based on biomass*, whereas other scientists (e.g. Puelzl *et al.*, 2014; Kleinschmit *et al.*, 2014) argue that the word is still up for interpretation, depending on the contextual use. McCormick and Kautto (2013) define bioeconomy as an economy where resources for materials, chemicals and energy are derived from renewable sources. In this sense, bioeconomy could be said to be a subcategory of CE, since CE can work as an *umbrella concept* for various disciplines (Merli *et al.*, 2018). Nonetheless, despite current efforts to find a clarification, a consensus on the understanding of the concept is far from being reached.

Moreover, recent understandings of unsustainable resource use have led to several global initiatives, some of the most significant agreements being made by the United Nations, **UN**, and its different organisations (Beynaghi *et al.*, 2016). In 2015, the member countries of the **UNFCCC**, the United Nations Framework Convention on Climate Change, decided to further accelerate investments associated with actions mitigating climate change, a decision referred to as the Paris Agreement (UNFCCC, 2019, 1). This agreement is, together with the Sustainable Development Goals, **SDG's** (UN, 2019, 1), supposed to serve as guidelines for sustainable development.

1.2 Problem

"We must change almost everything in our current societies. The bigger your carbon footprint, the bigger your moral duty. The bigger your platform, the bigger your responsibility" - Greta Thunberg (The Guardian, 2019, 1). In January 2019, Thunberg held a speech where she stated that sustainable development demands change, a change based on the understanding of moral obligations and politics (*ibid.*). Indeed, when it comes to change on a global scale, much hope

is placed on young generations' understandings and enactment (Percy-Smith & Burns, 2013). In Sweden, this can for instance be seen in the success of Greta Thunberg's protests and the spread of Climate Calls in Higher Education, **HE** (e.g. LU, 2019, 1). These actions are positive, when looking at the SDG for Quality Education, which states that all learners should acquire skills needed to promote sustainable development (UN, 2019, 2.). However, how this should be accomplished without a common definition of sustainable development, is currently a question without answer.

Higher Education for Sustainable Development, **HESD**, is a growing field of research, and an important part of Education for Sustainable Development, **ESD**, in Europe (Adomssent *et al.*, 2014). The most important reason behind the escalation of studies on higher education is that the vital **SD**, Sustainable Development, competencies future professionals should master are learnt at those educational institutions. Moreover, universities, in the form of societal institutions, need to embrace their responsibility of raising awareness and influence regional, sustainable change (Dlouha *et al.*, 2013).

However, as with SD in general, HESD still has a long way to go (Lozano *et al.*, 2013). There is a need to look further into HE on an international level, to investigate whether students develop the SD expertise society wants them to (Adomssent *et al.*, 2014), as well as to explore the causality between commitment, or political strategies, and SD implementation (Lozano *et al.*, 2015; Beynaghi *et al.*, 2016). In other words, the question "How can scholars help to accelerate sustainable change?" remains unanswered. Nonetheless, if we envision SD based on the **TBL**, Triple Bottom Line (Figure 1), there might be different solutions depending on which dimension we focus on.

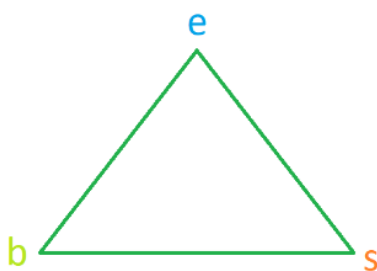


Figure 1. The three dimensions of sustainability, that is, financial (e), social (s) and biological (b) value. The figure is based on the concept Triple Bottom Line, developed by Elkington (2006).

Figure 1 above illustrates the TBL, that is, the three dimensions of sustainability. Wayne and MacDonald (2004) describe that the TBL was built on the idea that "a corporation's ultimate success or health can and should be measured not just by the traditional financial bottom line, but also in social/ethical and environmental performance" (*ibid.*, p. 243). Consequently, such financial sustainability can be reached, as discussed above, through moving toward a CE (Esposito *et al.*, 2018). But which scholars should possess knowledge about CE, and bioeconomy, and what do these scholars actually know?

In Sweden, the answer to the first part of this question is; forest stakeholders. This, since forests play an important part in the Swedish bioeconomy (Hodge *et al.*, 2017; Government Offices of Sweden, 2019, 1), which for instance is shown in the demand for a National Forest Programme (Skånberg *et al.*, 2016). Moreover, the demand and usage of wooden products are expected to grow both within the country and in Sweden's export countries, partly as a result of climate changes and more intense management (*ibid.*). Correspondingly, bioeconomy competence is predicted to be the key solution in all of Skånberg *et al.*'s (2016) future scenarios for the Swedish bioeconomy market. To meet this increasing demand of knowledge, Skånberg *et al.* (2016)

claim that the state is responsible to include SD planning in all university programmes, as well as backing programmes with a focus on the biomolecules' life cycle.

However, the second part of the question, “*what do these scholars [the forest stakeholders] actually know?*” is still unclear. Sweden is a part of the European Union, and as such, shares its visions for the future of bioeconomy (EC, 2019, 1). The European Commission, **EC**, states that it aims to, with its bioeconomy approach, provide new opportunities for the forestry sector, in terms of creating new products, replacing non-renewable products, and develop new business models that evaluate forestry ecosystem services (*ibid.*). When investigating whether this goal will be realised or not, studying forest stakeholders' perception of bioeconomy becomes vital.

In 2017, Hodge *et al.* (2017) managed to map how bioeconomy was perceived by three main groups of forest stakeholders; the Environmental Non- Governmental Organisations (**ENGO**'s), the industry and the forest owners in Sweden. However, they did not investigate how the future forest stakeholders visualised bioeconomy. This points to the need to investigate how young individuals, the future managers of the forest resources, perceive the concept of bioeconomy. Moreover, measuring learning outcomes, in management education and consumption education, is something of high importance for the future of HESD (Adomssent *et al.*, 2014). Therefore, the views and understandings of bioeconomy among students studying forestry are of high importance.

The Swedish University of Agricultural Sciences, **SLU**, offers two forestry programmes (SLU, 2019, 1; SLU, 2019, 2). One is a forestry bachelor programme of three years, and one is a forestry master programme of five years. At both programmes, the first two years focus on providing the students with basic knowledge about the forest industry in Sweden. During the later semesters, the students are able to choose courses more individually, giving them a certain specification in the field (SLU, 2019, 1; SLU, 2019, 2). Furthermore, SLU is obliged to educate for SD (SLU, 2019, 3), and currently has goals for the SDG's from Agenda 2030 to be implemented in their education (SLU, 2019, 4). This goes in line with the findings from Lozano *et al.* (2015), where they stress the positive effects signing a declaration can have on an institutions' sustainability work, and further recommend higher educational leaders to ensure that these SD ambitions are implemented throughout the system.

Based on the need for better understanding of SD, HESD and bioeconomy, as well as the likelihood that the forestry students at SLU will become future forest stakeholders, how these students perceive bioeconomy and whether this differs between the level of study, become questions of high interest to investigate. Moreover, how the SDG's of relevance are reflected in the curriculums of the forestry programmes, as well as in the students' perspectives on bioeconomy, should be examined to gain an understanding of SLU's sustainability implementation at the forestry programmes this far.

1.3 Aim and research questions

The aim of this research is to explain how students in forestry related programmes perceive the concept **bioeconomy**. The focus of this project is placed on a university that offers two forestry-related educational programmes; the Swedish University of Agricultural Sciences, SLU.

To explain this, the following research questions are of particular interest:

1. What is bioeconomy, according to Swedish forestry students?

2.
 - a) How do the students perceive the *forests*’ role for the Swedish bioeconomy?
 - b) How does this differ between bachelor and masters’ level?
3.
 - a) How do the students perceive the *higher educations*’ role for the Swedish bioeconomy?
 - b) How does this differ between bachelor and masters’ level?
4. How is the relation between the SDGs and the forestry programme curriculums, and how are these goals reflected in the student responses?

1.4 Outline

Figure 2 illustrates the skeleton of the thesis by showing the correlations between the chapters, as well as the problems and conclusions relation to the real world.

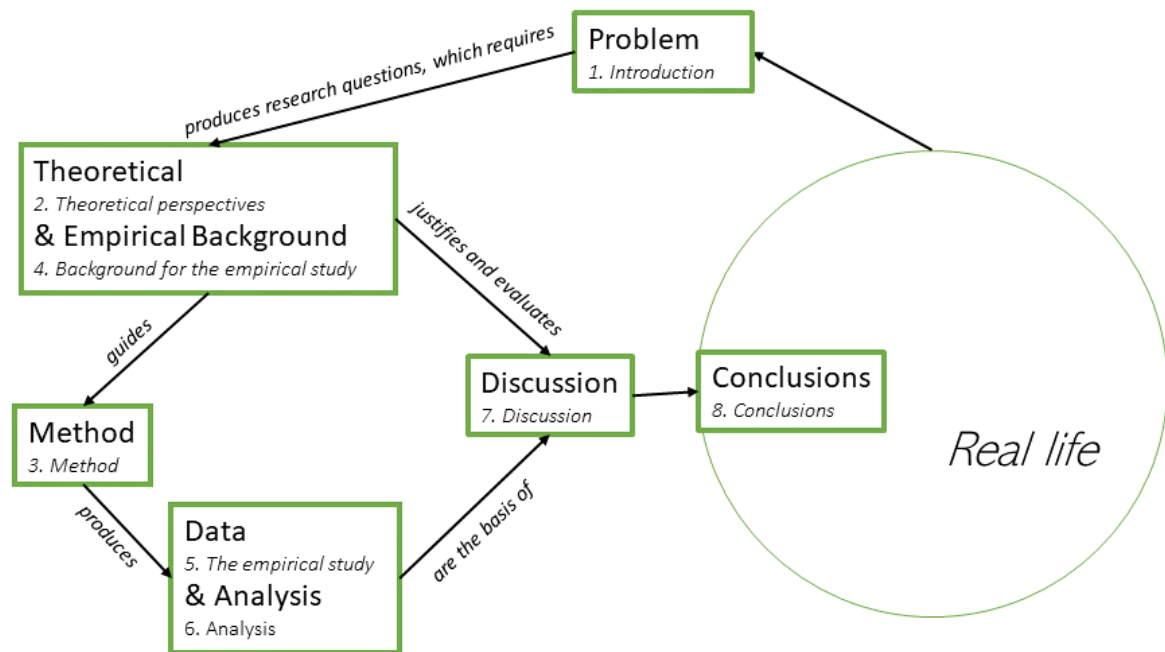


Figure 2. Illustration of the outline of the study, inspired by Carter & Little (2007, p. 1317).

The problem and research questions are presented in Chapter 1 above. This chapter is followed by the *Theoretical perspective*, Chapter 2, which in turn guides the *Method* presented in Chapter 3. Chapter 4, *Empirical background*, helps to understand the *Empirical study* in Chapter 5 and the *Analysis* in Chapter 6, as well as justifies the *Discussion* in Chapter 7. Finally, Chapter 8 presents the *Conclusions*.

2 Theoretical perspectives

Chapter 2 provides an account of the theory behind this study. It starts with the central concept forest-based bioeconomy, then moves on to the role of Higher Education for sustainable change, and finally ends up with a conceptual framework.

2.1 The forest-based bioeconomy

The understanding of forest-based bioeconomy is a moving target (Puelzl *et al.*, 2014). Although used frequently in societal dialogues, whether it is a political (e.g. Government Offices of Sweden 2019, 1) or corporate (e.g. Swedish Forest Industry Federation, 2019, 1) discussion, the interpretations of the concept vary to a great extent. These different interpretations of the forests' role in bioeconomy are also reflected in the current academic output. To give the reader an overview of this, a selection of interpretations from academia and organisations are shown in Table 1.

Table 1. Interpretations of the forests' role in bioeconomy from the literature

Authors	Interpretation of bioeconomy	The forests' role in bioeconomy
Hodge <i>et al.</i> , 2017	The “ <i>part of [an] economy built on the sustainable production of renewable materials from nature</i> ” (p. 584)	A significant contributor
	A “ <i>function of individual understandings rather than beliefs held in common for an actor group</i> ” (p. 585)	“ <i>A part of a greener future</i> ” (according to forest owners and industry) (p. 585)
	In Sweden it is “ <i>a buzzword, but a useful buzzword</i> ” (p. 586)	Bioeconomy is “ <i>a tool for society to accept forestry as it is</i> ” (p. 585), in other words: Bioeconomy = current forestry practice (according to forest owners)
Kleinschmit <i>et al.</i> , 2014	Bioeconomy reflects the “ <i>call for a shift toward a society relying strongly on renewable biological resources while achieving economic growth</i> ” (p. 402)	An important contributor to “ <i>sustainable resource use and environmental protection taking into account the (...) ecosystem services from forests</i> ” (p. 407)
Puelzl <i>et al.</i> , 2014	Bioeconomy “ <i>interweaves arguments of doom (limits to growth) with technological arguments (ecological modernisation) and economic arguments (neoliberalism) while being concerned mostly about the economy</i> ” (p. 391)	Entities providing energy and biomass, sinks for carbon sequestration
Skånberg <i>et al.</i> , 2016	A “ <i>specific sector, the part of the total economy that is based on biomass</i> ” (p. 3)	In Sweden, the forest (forest ecosystem services excluded) stands for the majority of the bioeconomic export, and is also of significant size when it comes to the country's bioeconomy-related production value and work opportunities (p. 5)
SSNC, 2019, 1	<i>Interpretation missing</i>	The raw material from the forest will replace everything; fossil fuels, plastics, building material

		The forest should provide more of everything, an attitude where the analysis of the consequences for the environmental goals is absent.
Swedish Forest Industry Federation, 2019	Using renewable resources from the forest, the soils and the sea instead of fossil fuels and materials to lessen the climate impact. (<i>ibid.</i> , 1)	Material for packaging, wood for house construction, textile fibres, biofuel and bioenergy (<i>ibid.</i> , 2)

Small similarities aside, e.g. the continued use of the word “renewable”, Table 1 shows that there still is no set definition of the word *bioeconomy*. Moreover, the *forests’* role in said economy is even more unclear. For instance, Kleinschmit *et al.* (2014) claim that ecosystem services are a part of the forest-based bioeconomy, whereas Skånberg *et al.* (2016) exclude said services when discussing the value of Sweden’s forest-based bioeconomy. In addition, the Swedish Society for Nature Conservation, **SSNC**, state that the forest-based bioeconomy lacks an analysis of the environmental consequences (SSNC, 2019, 1), whereas the Swedish Forest Industry Federation (2019, 2) only mention the forest as a resource for e.g. packaging and construction material.

2.2 Students as future forest stakeholders

Even though the definition of what a stakeholder *is* has varied over the years, there is consensus regarding what *entity* a stakeholder can be, which is; a person, a group, an organisation or an institution (Mitchell *et al.*, 1997). Who the stakeholder is depends on what is at stake, and how that is related to the entity in terms of power, legitimacy and urgency (*ibid.*). However, Roberts (2003) argues that when it comes to a company, one stakeholder can have multiple roles, which is shown in Figure 3.

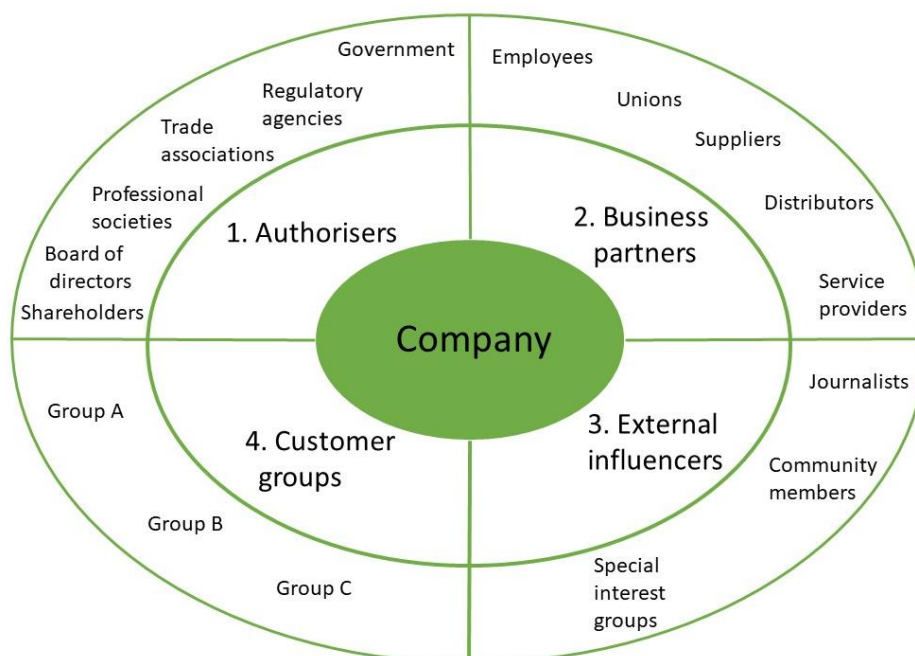


Figure 3. The roles of stakeholders, adapted from Roberts (2003, p. 162).

In Figure 3, four main stakeholder roles are presented, with sub-categories for each role. The main groups are; authorisers, business partners, external influencers and customer groups

(Roberts 2003). *Authorisers* authorise and monitor the company's performance. *Business partners* carry out the actions of the company, usually being employees or suppliers. *External influencers* can for instance be the media, an NGO, Non-Governmental Organisation, or anyone else who has an interest in the company due to its impact on the world. Lastly, the *Customers* are divided into sub-groups since their interest in the company's product differ between them, and therefore their perceptions of the company differ as well (*ibid.*). However, in contrast with Roberts (2003), Svendsen and Laberge (2005) describe a paradigm shift where the view on problem-solving strategies for sustainability issues shifts from being *organisation-centric* to *network-focused*, as shown in Figure 4 below.

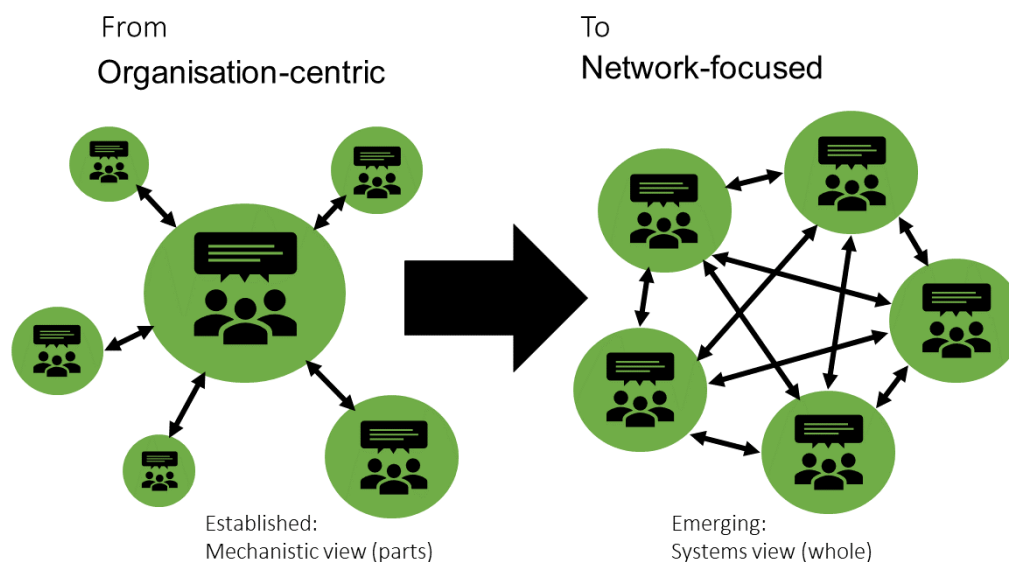


Figure 4. Illustration of the shift to systems view in stakeholder engagement, based on Svendsen and Laberge (2005, p. 97).

Figure 4 shows how a *systems view* has emerged in the field of sustainability (Svendsen and Laberge, 2005). This newer, more holistic way of looking at sustainability issues, where the problem instead of the organisation is at the centre, works well when looking at a bioeconomy. If the question of bioeconomy development is the central issue, the roles, interactions and perceptions of the stakeholders become relevant to deduce.

In Sweden, Hodge *et al.* (2017) investigated the perceptions of bioeconomy among forest owners, the forest industry and ENGO's.

In the terms of the stakeholder roles presented by Roberts (2003), forest owners can be said to belong to both authorisers, as part of *trade associations*, and business partners, as *suppliers*. The forest industry is part of the same groups but for different reasons, acting in the group of authorisers as *shareholders* and in the group of business partners as *employees* and *distributors*. Finally, the ENGO's belong to the group of external influencers, as *special interest groups*.

In their study, Hodge *et al.* (2017) found that “whether motivated by a need for society to be sustainable or a need for the industry to survive, all of the interviewees see bioeconomy as a desirable future” (Hodge *et al.*, 2017, p. 586). However, the notion of what bioeconomy means differed to some extent between the stakeholders, and the industry but foremost the forest owners perceived the concept as a way to protect the traditional forestry practise from potential changes. Moreover, bioeconomy was seen as a more-of-everything-pathway, where the limited forest resources are expected to suffice, even when the demand increases, due to increased efficiency in the industry (*ibid.*).

Missing from the study by Hodge *et al.* (2017) is a student perspective, which could give an insight into these future forest stakeholders' perceptions. In their future work life, forestry master graduates are likely to work in as leaders within the forest industry, at governmental agencies or as forest scientists (SACO, 2019, 1). Additionally, forestry bachelor students usually work with administrative tasks in the industry or at the governmental institutions (SACO, 2019, 2). This means, that the forestry students likely will act as authorisers and business partners, although the students can and most likely will take on the roles of all four stakeholder groups at different occasions in their lives. Thus, to be able to predict the future of bioeconomy, the student voices need to be heard.

2.3 Higher Education for Sustainable Development

Universities have, by their role as generators and communicators of knowledge, the capacity to raise awareness toward sustainability issues, both on a global and a regional level (Dlouha *et al.*, 2013). Additionally, they have been assigned the task to inspire critical thinking, which is vital when being faced with sustainability issues (Wiek *et al.*, 2011). Moreover, sustainability is suggested to increase in importance as a core mission for these institutions (Beynaghi *et al.*, 2016). Going from merely being a question of the human environment, the relationship between universities and SD has since the 2010's entered into a phase called Higher Education for Sustainable Development, HESD (*ibid.*). There is, however, still more to be done before sustainability will become a guiding principle in higher education (Lozano *et al.*, 2013).

The following sections describe the pedagogy needed to make the students in HE aware of SD, as well as the suggested leadership needed for SD implementation.

2.3.1 Critical Pedagogy as a part of Higher Education for Sustainable Development

Bizzel (1991) describes **CP**, Critical Pedagogy, as a form of pedagogy that should promote egalitarian power relations. She further explains that the concept should be seen as an assortment of practises rather than one specific method. Similarly, Breuing (2011) found in her literature study that the field of CP historically has had both contradicting and overlapping definitions of the concept. Likewise, her respondents' descriptions of the central purposes of CP differed greatly, even though the majority of them identified as critical pedagogues themselves (*ibid.*). However, for this study, Bizzel's (1991) definition above will be used.

When it comes to education for sustainability, The SDG 4.7 state that all learners should “*acquire the knowledge and skills needed to promote sustainable development, including [...] human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development*” (UN, 2019, 2). In this context, CP, as reflected by Breuing (2011) and Bizzel (1991), is of great importance as a tool to reach this goal. Moreover, another important aspect in HESD is the role of creativity. Sandri (2013) states for instance that the venture for sustainable development is dependent on innovation, and therefore has education for creativity at its heart. They further argue that to “*ignore creativity in Efs [Education for Sustainability] is to ignore a key tool in creating social and technological change*” (*ibid.*, p. 768). In conclusion, it can be said that CP and creativity are elements of high importance in HESD, especially when the SDGs' are considered.

2.3.2 Leadership for Sustainable Development implementation

Lozano *et al.* (2015) found a strong correlation between an institution's sustainability implementation and signing a declaration or initiative. In their conclusion, they therefore recommend that HE leaders commit to SD by integrating SD into policies and establishing both short and long-term plans. This is something supported by Adomssent *et al.* (2014) as well.

In another report, Lozano *et al.* (2013) propose that university leaders need to be empowered to implement the SD paradigm, if the universities are ever to be a part in the transition to a sustainable society. The importance of transdisciplinary teaching and research is also highlighted, suggesting that this is the key to speed up the societal transformation. If the leaders become more proactive when it comes to SD initiatives, a sustainable future is not far from reach (*ibid.*).

2.4 A conceptual framework

A presentation of an analytical framework is presented below. It is based on section 2.1, 2.2 and 2.3, to guide the analysis in *Chapter 6*.

The sections above describe how creativity and innovation are two highly important competencies in HESD (e.g. Sandri, 2013). This can be applied to bioeconomy as well, since new, more sustainable products are aimed for (Kleinschmit *et al.*, 2014). Moreover, there is a need for students to be able to think critically for SD to take place (Bizzel, 1991; UN, 2019, 2). Finally, a general knowledge of the field of bioeconomy is needed if the field is supposed to change (Barth *et al.*, 2007).

Wiek *et al.* (2011) created a competence map for what should be learned in HESD. From this, three out of five total key competences (Figure 4) have been chosen based on their relevance for the development of bioeconomy, as well as their applicability to the premade survey by **PerForm**, Perceiving the Forest-based Bioeconomy (Appendix 1 & 2). These competencies were; *Systems Thinking Competence*, *Normative Competence* and *Anticipatory Competence*. These are closely connected to each other (Figure 5), since one can rarely be used for solving a sustainability problem, without using the other (Wiek *et al.*, 2011).

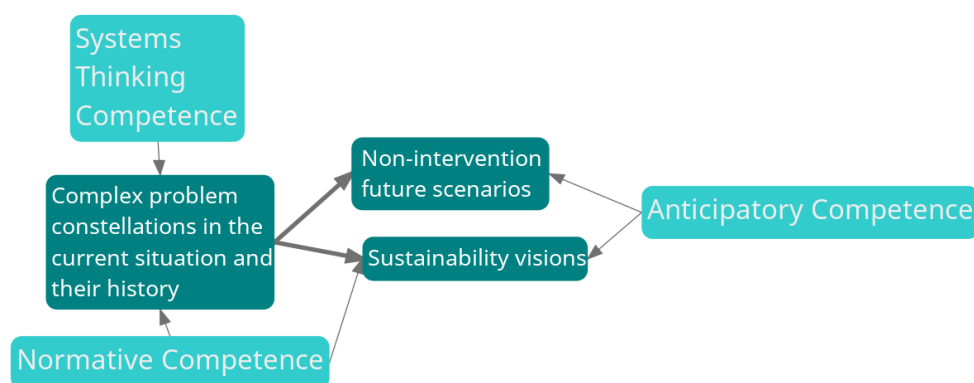


Figure 5. The key competences students should possess after HESD that will be measured in this study, and how these are interlinked. Adapted from the competence map in Wiek *et al.* (2011, p. 206).

Figure 5 above shows the chosen competencies from Wiek *et al.* (2011). They describe *Systems Thinking Competence* as the “ability to collectively analyse complex systems across different domains (society, environment, economy, etc.) and across different scales (local to global”, or

in other words *holistic thinking* (*ibid.*, p. 207). In a bioeconomy context, this could be seen as the ability to see bioeconomy as a problem or a solution not only for the forest industry, but for the society, and putting the effects of the practise into a global context. Moreover, *Normative Competence* is the “ability to collectively map, specify, apply, reconcile, and negotiate sustainability values, principles goals, and targets. This capacity enables, first, to collectively asses the (un-)sustainability of current and/or future states of social-ecological systems and, second, to collectively create and craft sustainability visions for these systems” (*ibid.*, p. 209). Another expression for this is *orientation/ethical thinking*. In a bioeconomy, Normative Competence can be shown as pointing out damaging standards in the current industry, as well as be aware of SD goals and have a vision for how these should be implemented. Furthermore, *Anticipatory Competence* is defined as the “ability to collectively analyze, evaluate and craft rich ‘pictures’ of the future related to sustainability issues and sustainability problem-solving frameworks” (*ibid.*, p. 207), something also described as *future thinking*. For a bioeconomy, Anticipatory Competence is important for innovation in the field, to envision where forest products and resources can be of use in the future, as well as understanding the consequences if these resources are not managed in a sustainable way. In Chapter 3.1, Table 3 shows how the three competencies above are linked to the survey questions investigated in this thesis.

The two competencies not chosen to be included in the framework were *Strategic Competence* and *Interpersonal Competence*. Strategic Competence is “the ability to collectively design and implement interventions, transitions and transformative governance strategies toward sustainability” (*ibid.*, p. 210), and Interpersonal Competence is “the ability to motivate, enable, and facilitate collaborative and participatory sustainability research and problem solving” (*ibid.*, p. 211). These competencies were excluded since they were incompatible with the survey being used for this thesis.

The goal of the upcoming analysis is to give an overview of what competencies the current forestry students consider to be of importance, as well as whether they indicate possessing one/more of these competencies themselves, in terms of the development of bioeconomy. This is done using the framework shown in Figure 6 below.

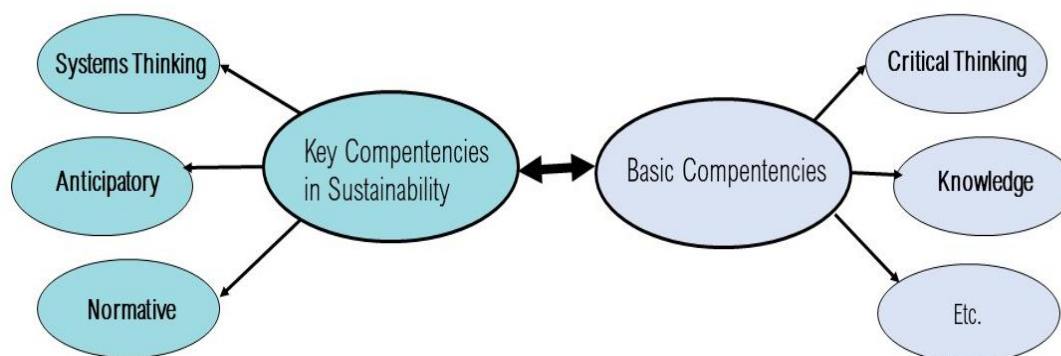


Figure 6. The framework used for the analysis of this study, adapted from Figure 3 in Wiek et al. (2011, p. 214).

Figure 6 shows the key competencies from Wiek et al. (2011), as well as the basic competences they suggest are of importance for sustainable development. *Critical Thinking* and *Knowledge* are here not defined as key competencies; however, they are important regular competencies learned in higher education (Wiek et al., 2011), and can be found in most HESD curriculums (e.g. SLU, 2019, 1). In the analysis, the framework will be used to give an overview of whether *Systems Thinking Competence*, *Anticipatory Competence*, *Normative Competence*, *Critical Thinking* and/or *Knowledge* are indicated in the student responses, respectively. Moreover, it will also be used as investigating what competence the students themselves believe are of importance, and how all of this correlates with the future of Swedish bioeconomy.

3 Method

This chapter demonstrates the steps taken to develop the research method and analysis of the data. It starts with presenting the literature review, continues to discuss the research and analysis design as well as to explain how the quality will be assured. In the end, the ethical considerations are described, followed by the delimiting choices made.

3.1 Approach

In Figure 7, there is an overview of what is to be done within the frame of PerForm, in relation to this report. Table 2 shows the research questions.

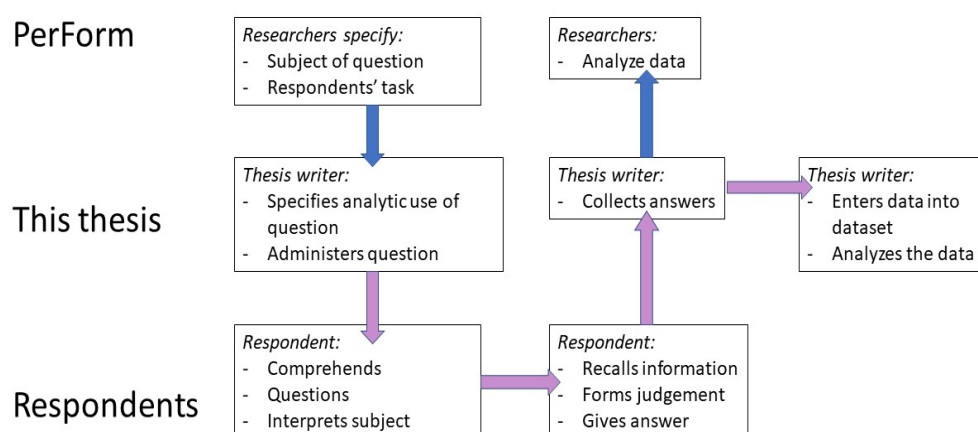


Figure 7. Model of this survey data collection process. Based on Czaja and Blair (1996) as shown in Robson (2002, p. 242). The purple arrows illustrate what will be done within this thesis, and the blue arrows what part PerForm has in the research process.

As shown in Figure 7 above, this thesis is part of the international research project PerForm (PerForm, 2019, 1). The method of the thesis has therefore partly been developed to fit the need of said project. That is, the survey about bioeconomy (Appendix 1 & 2), as well as the choice of students as respondents, were both decisions made by the PerForm team. However, the author of this thesis has, based on the theory in the previous chapter, developed the research questions and chosen a suitable analysis based on these. For information on how the survey was developed, see Chapter 3.4 below.

Table 2. Research questions in relation to the relevant survey questions and theory

	Research questions	Survey questions	Relevant literature/theoretical concepts
1	What is bioeconomy, according to Swedish forestry students?	(S11), (S13) (S72)	HESD, Bioeconomy, stakeholder theory,
2a	How do the students perceive the forests' role for the Swedish bioeconomy?	(S37), (S38)	CP, HESD, Bioeconomy
3a	How do the students perceive the higher educations' role for the Swedish bioeconomy?	(S24), (S25), (S71)	CP, HESD, Bioeconomy Forestry students, Empirical

2b & 3b	How does this differ between bachelor and masters' level?	(S64), (S65)	Background
4	How is the relation between the SDGs and the forestry programme curriculums, and how are these goals reflected in the student responses?	(S11), (S13), (S24), (S25), (S37), (S38), (S71), (S72)	CP, HESD, SDG

Table 2 above shows the research questions for this thesis, in relation to the relevant survey questions used and the theory applied. Below, Table 3 illustrates the relevant survey questions in detail, linked to the basic and key SD competencies discussed in *Chapter 2*. The meaning of survey question S24 differed between the two languages Swedish and English, and therefore, the Swedish version (which is the one used *in situ*) has been translated to English by the thesis author to account for the results (Table 3).

Table 3. Survey questions chosen for analysis related to the competencies from the conceptual framework

Nr	Question	Competence (/Competencies)
S11	Have you ever heard about bioeconomy or bio-based economy? (yes/no)	Systems Thinking, Basic (Knowledge)
S13	How would you define bioeconomy, according to your personal understanding?	Systems Thinking, Basic (Knowledge)
S24	How much are you satisfied with the extent to which bioeconomy is currently addressed within your program? (scale 1-5)	Normative, Basic (Critical Thinking)
S25	Do you think it is necessary to address bioeconomy more in your University's curricula? (scale 1-5)	Normative, Basic (Critical Thinking)
S37	In your opinion, how relevant is the current role of forests within bioeconomy in the country where your academic program is offered? (scale 1-5)	Systems Thinking, Normative, Basic
S38	Please motivate your choice by reporting the main reasons/arguments for attributing such a role.	Systems Thinking, Normative, Basic
S71	What obstacles do you see for the forest-based bioeconomy in today's education?	Systems Thinking, Normative, Anticipatory, Basic
S72	What competencies do you believe are of importance within the forest-based bioeconomy?	Systems Thinking, Normative, Anticipatory, Basic

In Table 3 above, the number of competencies per survey question varies. This is the consequence of the studied questions being either are open-ended or have fixed answers (e.g. scale 1-5), and thus giving room for the different competencies to be indicated. Note, however, that indications of all competencies from Figure 6 could be found in a majority of the survey answers studied. The goal of the upcoming analysis is to give an overview of what competencies the current forestry students consider to be of importance, as well as what competencies they

possess themselves, in terms of the development of bioeconomy. This will be done using the framework shown in Figure 5 in *Chapter 2*.

3.2 Literature review

In the method book “Real World Research” (Robson, 2011), literature reviews are claimed to be of high importance since they reveal potential knowledge gaps in the researched field. Moreover, they are needed for uncovering variations in findings, which can help explain differences in the result (*ibid.*).

For this research project, finding relevant material for building a conceptual framework was vital, since the PerForm project did not have a clear framework at a central level (*pers. com.*, Holmgren, 2019). The literature review commenced when the project started, and it continued throughout the project time, giving rise to problem insights as well as conceptual development. This is also the case for literature on bioeconomy, since that field of research is an ever-moving target (Puelzl *et al.*, 2014).

When doing a literature review, it is recommended to use more than one database (Robson 2011). Therefore, for this research two databases were used; Web of Science and Google Scholar. However, this is still no guarantee that no relevant information is missed (*ibid.*). To tackle this issue, the literature chosen for this thesis was put in perspective and compared with the sources of the PerForm group, as well as reports recommended by scientist knowledgeable in the field.

The most relevant search words used were bioeconomy, circular economy, higher education (for sustainable development), forest (/forestry) and critical pedagogy. In the search process, they were then combined according to Table 4 below.

Table 4. The most frequent search words, and how they were combined. X indicates a combination, Y a combination where nothing of relevance was found, and – indicates no combination of the words

	Bioeconomy	Circular economy	Forest (forestry)	Higher education (for sustainable development)	Critical pedagogy
Bioeconomy	-	X	X	X	-
Circular economy	X	-	X	X	-
Forest (forestry)	X	X	-	Y	-
Higher education (for sustainable development)	X	X	Y	-	X
Critical pedagogy	-	-	-	X	-

Table 4 shows the combination of the most used search words and whether these combinations were fruitful or not. The combinations marked X led to the discovery of the research used in this thesis.

The papers used were chosen by their relevance as well as their publication date, where a more recent publication was preferred over publications from over a decade ago, since both bioeconomy and sustainability in higher education are two relatively new and growing fields of research. The relevance was decided by the topic discussed, and the number of times the article had been cited, to assure a high quality of the source material. The two most frequently used journals were *Journal of Cleaner Production* and *Scandinavian Journal of Forest Research*. Moreover, since the result of this research shows a snapshot in time, popular literature or magazine quotes were used as well, to show the “here and now” perspective. These have however only been used in the problem description, and not in the theoretical background. In conclusion, there is a large variety of research related to HESD, CP and Bioeconomy, as there are many interpretations of both sustainability and bioeconomy (see *Chapter 2*).

3.3 Research design and unit of analysis

A *non-experimental fixed design* (Robson, 2002) was chosen as the best way to answer the research questions with the help of the PerForm survey. “*Relational fixed designs measure the relationship between two or more variables [...] What is the relationship between school characteristics and student achievement?*” (*ibid.*, p. 155). This quote indicates that to be able to study the relationship between the variable “level of studying” and the perception of bioeconomy, a relational fixed design is a sensible choice. This also applies to the overall aim with this thesis (to explain how forestry students perceive bioeconomy), since non-experimental fixed designs can be used for such a descriptive purpose (Robson, 2011). Additionally, since it is the students’ perceptions that are investigated, the unit of analysis is, consequently, the students themselves (see Figure 8).

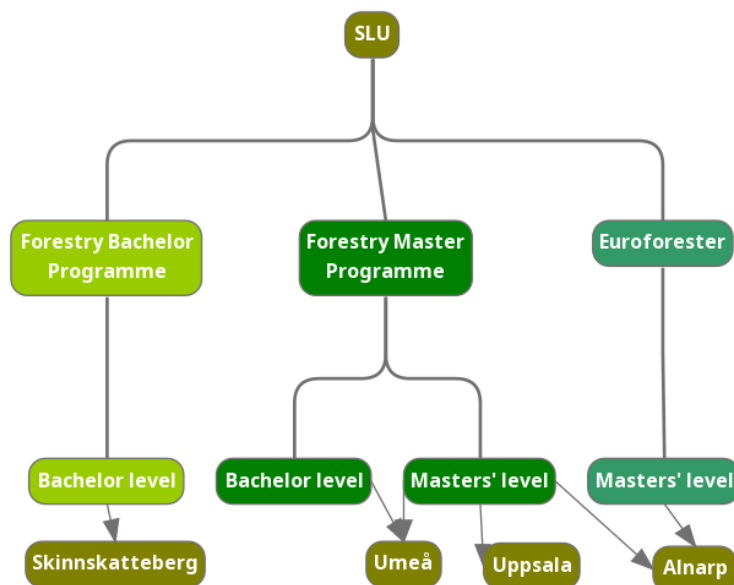


Figure 8. Illustration of the forestry student population at SLU. The forestry bachelor programme and forestry master programme are studied in this thesis. The unit of analysis is the bachelor level and masters’ level at the two programmes.

Figure 8 shows the different groups of students studying forestry in Sweden at **SLU**, divided by year of studying and programme. The students within the two groups bachelor programme and master programme represent the units of analysis.

An advantage of a non-experimental fixed design is that it is likely to not disturb “*whatever it is we are interested in*” (Robson, 2011, p. 123). Moreover, they are of good use when trying to

understand a phenomenon (*ibid.*). These two statements provide good arguments for why this design-type can be used to study perceptions. However, when investigating the relationship between two or more variables, it is important to note that correlation does not always imply causation. If the researcher wants to statistically generalise the findings of a survey, a big and heterogenic sample size is needed (*ibid.*) and the sampling needs to be driven by chance (Samuels & Witmer, 2003). Thus, since the survey for this thesis is for a total population of 416 students (*pers. com.*, Eriksson, 2019), where each respondent contributed in a non-random way, only a statistical generalisation in the form of *descriptive statistics* can take place.

3.4 Survey creation and data collection

This subchapter shows the process of creating the student survey, which was designed by researchers in the PerForm project as well as the collection of the data. The design choices were based on the researchers' previous articles on the subject. The theory that supports the survey questions investigated in this thesis is presented in Chapters 2 and 4.

The survey used in this study was created by a research team at **TESAF**, University of Padova (Italy), with the support of PerForm consortium (*pers. com.*, Masiero, 2019). It is composed of open-ended questions and questions with fixed alternatives for answers, such as multiple choice-answers and rating scale questions. It originally consisted of six parts:

1. *The students' pre-knowledge of bioeconomy*, which explores how familiar the students are with the concept
2. *Bioeconomy at the university*, where it is investigated whether bioeconomic education is present at the university or not
3. *Bioeconomic perspectives*, which explores how the students perceive the bioeconomy in their own country and in Europe as a whole
4. *The problems and possibilities of bioeconomy*, where the students can show what problems and/or opportunities they relate to bioeconomy
5. *The future perspective related to bioeconomy*, where future job desires and expectations of students were studied
6. *Information about the respondent*, where the students filled in their age, gender, nationality, university and semester of attendance

A pilot test was done before the survey became accessible, where a low number of students were instructed to test the survey in order to identify potential gaps or improvements needed (*pers.com.*, Masiero, 2019). Based on the feedback from this pilot test, a few improvements were made. For instance, the likert scale of some answers were changed, since they could not confer the right sense from the questions, e.g. a scale based on frequency (never, often, etc.) was changed to quantity (not all, all, a lot, etc.) (*ibid.*).

The survey was further translated from English to Swedish by the researcher responsible for the Swedish PerForm results, Sara Holmgren. An additional, seventh survey part was added, by Holmgren together with the author and the supervisor for this thesis project (*cf.* Appendix 1):

7. *Two questions to clarify*, where the students were asked about the potential obstacles for bioeconomy in their education, as well as the competencies they thought were of importance in the forest-based bioeconomy

The survey answers were collected during a period of six weeks, see Table 5. First, the forestry students at SLU were invited via email and social media to, at each campus, a computer hall where they could answer the questions in exchange for coffee and pastry, as well as the chance of winning a gift card. Second, links in English and Swedish to the survey were sent out via email to the SLU students. The languages used were Swedish and English, depending on the respondents' preference. However, only the Swedish results were analysed for this thesis, since the English version of the survey did not have the additional questions S71 and S72. The survey results were then translated to English by the author of this thesis.

Table 5. Timeline for data collection

7th and 8th of March	11th and 12th March	18th and 19th March	21st and 22nd March	26th and 27th March	1st of April	14th April
Tested the survey on 3 students	Performed the survey in Uppsala	Performed the survey in Skinnskatteberg	Performed the survey in Umeå	Performed the survey in Alnarp	Sent out the links via email	The survey was closed
Got feedback on how to interpret the answers and where problems might arise	Respondents came for coffee and to support the research	Respondents came for coffee, pastry, the gift card and to support the research	Respondents came for coffee, pastry, the gift card and to support the research	Respondents came for coffee and to support the research	-	-

Table 5 shows the timeline for the data collection, as well observations at these certain events that were useful moving forward with the research.

3.5 Data analysis

For the analysis, survey data was chosen based on which questions best could answer the research questions. These answers were from both of the two types of questions: open-ended questions and questions with fixed alternatives for answers. Thus, the result section and the analysis were divided into two parts: one for each question type (see 3.5.2 and 3.5.3 below).

3.5.1 Focus in the survey

Since the survey was 42 questions long and touching upon many different areas within the field of forest-based bioeconomy, it was important to find a focus for this thesis. To do this, the survey was studied and the questions which were best able to answer research question 1 and 2 for this paper were chosen (Table 6). The survey as a whole can be found in *Appendix 1 & 2*.

Table 6. Overview of the competencies and what research question(s) they are planned to answer, as well as the survey questions they are linked to (clarification: this does not mean that the survey questions in one row can answer the research question(s) on their own)

Competence	Research question(s) linked to the competence	Survey questions linked to the competence
Systems Thinking Competence	1. What is bioeconomy, according to Swedish forestry students? 2. How do the students perceive the forests' role for the Swedish bioeconomy? 3. How do the students perceive the higher educations' role for the Swedish bioeconomy?	Bioeconomy (S11) & (S13), Role of Forestry (S37) & (S38), Obstacles (S71), Competencies (S72)
Normative Competence	2. How do the students perceive the forests' role for the Swedish bioeconomy? 3. How do the students perceive the higher educations' role for the Swedish bioeconomy?	Education (S24) & (S25), Role of Forestry (S37) & (S38), Obstacles (S71), Competencies (S72)
Anticipatory Competence	2. How do the students perceive the forests' role for the Swedish bioeconomy? 3. How do the students perceive the higher educations' role for the Swedish bioeconomy?	Obstacles (S71), Competencies (S72)
Basic Competencies	1. What is bioeconomy, according to Swedish forestry students? 2. How do the students perceive the forests' role for the Swedish bioeconomy? 3. How do the students perceive the higher educations' role for the Swedish bioeconomy?	Bioeconomy (S11) & (S13), Education (S24) & (S25), Role of Forestry (S37) & (S38), Obstacles (S71), Competencies (S72)

Table 6 above shows the chosen survey questions in relation to the relevant competencies, as well as the research questions. This was followed by two other survey questions were used for the analysis, to be able to answer research questions 2b and 3b (Table 7).

Table 7. Survey questions of relevance for research question 2b & 3b

2b & 3b	How do these perspectives differ between bachelor and masters' level?
S64	Enrolled at program
S65	Semester of attendance

Table 7 illustrates the two survey questions studied to answer research question 2b and 3b, which are asking the respondents what programme (master or bachelor) they are enrolled at, and what semester they are currently in.

3.5.2 Analysing the fixed alternatives questions

To be able to present the data acquired from the *fixed alternatives* questions, descriptive statistics were used. Descriptive statistics allows the user to organise and summarise the data

given by the sample, but cannot, in contrast with inferential statistics, draw a conclusion for the total population from the sample (Samuels & Witmer, 2003). To be able to use inferential statistics, the data needs to be collected through a true experiment, i.e. a random sampling process (Samuels & Witmer, 2003), and for this thesis that was not the case, since the collection process was biased in favour of students available at the campuses at the time of collection.

The data consisted of ordinal categorical variables (*ibid.*), i.e. scale values ranging from 1 to 5 where each value had a distinctive description (e.g. 1= *not satisfied*, 2= *slightly satisfied*, 3= *quite satisfied*, 4= *satisfied* and 5= *very satisfied*), and it was reworked using *Excel*. Charts with the responses of the response-percentages for the study levels were created. Additionally, two types of measurements of central tendency were calculated, the mean values and the medians, to see whether the answers from the sample was more of a heterogeneous or homogenous nature (*ibid.*). Finally, comparisons between study levels were made, looking to see whether there is a connection between perception and study level, answering the research questions 2b and 3b.

3.5.3 Analysing the open-ended questions

For the *open-ended* questions, the data consisted of the free-text answers from the survey. These were translated from Swedish to English by the author of this thesis, and then put into the online survey platform *Netigate* to create so called *word clouds*. A word cloud is an image of the words used in the answers, where the size of the word corresponds to their usage frequency (Netigate, 2019, 1). To make the word clouds easier to read, words without intrinsic value were erased from the word clouds (such as *has*, *which*, *thus*, *get* etc.) together with the words only used once. This was useful when wanting to give a simple overview of the perceptions. However, the most frequently used words do not show the whole truth, since the contexts they are used in can vary greatly. Thus, a *thematic coding analysis* was conducted, built on the method described by Graneheim and Lundman (2004), where the answers are put in a table and broken down in two steps to get a code for what the respondent states (Table 8). If something was unclear and hard to interpret, it was possible to go back to the Swedish data to clarify. This is a very subjective method, and therefore an example of the coding, survey question S71, can be found in *Appendix 3* to give the reader some insight in how the researcher for this thesis interpreted the answers.

Table 8. The free-text answers were analysed with the method illustrated in Graneheim and Lundman (2004, p. 107), illustrated with 3 answers from S71

Person	Meaning unit	Condensed meaning unit	Code
A	Conservatism, bureaucracy and fear of failure	-	Conservatism Bureaucracy Fear
B	That it maybe feels a little blurry and that the education isn't developed in line with society	Blurry word and education that isn't in line with society	Concept unclear Lack of societal connection
C	Bureaucracy and old-fashioned way of thinking	-	Bureaucracy Conservatism

Table 8 shows an adaptation of the method presented in Graneheim and Lundman (2004),

practised on three responses given when the respondents were asked question S71 “*What obstacles do you see for the forest-based bioeconomy in today’s education?*”. Besides codes, interesting quotes were also subjectively collected directly from the free-text answers, to be used in the discussion as summarisations or examples of different perceptions.

An advantage of thematic coding analysis is that it is “*accessible to researchers with little or no experience of qualitative research*” (Robson 2011, p. 477). Further, it is suitable for many various types of qualitative data and provides a way to summarise key features of said data. A disadvantage is that the procedure is rarely accounted for in its full form (*ibid.*), however in this thesis an example of the process is given in *Appendix 3*. Moreover, the flexibility of the method can make it difficult for the researcher to find a focus in the analysis (*ibid.*). Nonetheless, in this thesis the potential lack of focus in the tables showing the analysed data can be explained by the aim of the study: to describe the students’ perceptions, aiming for an overview rather than a thorough evaluation.

3.5.4 Goals and curriculums of the forestry bachelor and master programme

The forestry programme curriculums for SLU were found and narrowed down to the parts being of relevance for the two SDG’s applicable to forestry education, presented in *Chapter 4*. In *Chapter 6* they were together with the SD competencies from Wiek *et al.* (2011) compared with the student responses. This, to give an answer to research question 4.

3.6 Quality assurance

This subchapter gives an account for the achievement of quality assurance of this study, discussing the *internal validity*, the *external validity* and the *reliability* needed.

Internal validity

Since the survey was designed by PerForm researchers in beforehand, the way the survey is written, is out of the hands of this thesis (see Figure 6). However, potential unclear questions were addressed and managed by the collector of the data *in situ*, see below. Moreover, the Swedish questionnaire was tested on three forestry students in beforehand, to note potential uncertainties and prepare to answer similar questions before the larger sampling commenced.

A disadvantage with using a survey to answer a research question is that even though it produces a large amount of data, which is usually a sign of a high-quality answer, the *nature* of the data can be questionable (Robson 2002, p. 230). There is a risk that the respondents answer what they *think* the researcher wants to hear or what will put them in a good light, a so-called *social desirability response bias*, rather than giving their actual opinion (Robson, 2002). However, for this work the risk was minimised by the questionnaire being self-administered and anonymous, which can “*encourage frankness*” from the respondent (*ibid.*, p. 241). Moreover, if the survey is self-administered, the response rate might be low. There is also a chance that there will be misunderstandings of the survey, that would avoid detection if the researcher is absent (*ibid.*). To avert these two problems for this thesis, the researcher was present during the data collection, able to motivate respondents and answer any occurring questions. Nonetheless, this could have led to a problem of its own: the data could be affected by the interactions between the researcher and the respondent (*ibid.*).

In general, since no inferential statistics could be run for this thesis, it is very clear that correlations found in the results does not have to imply causation (Robson, 2011). The results from this thesis cannot be seen as *evidence* for a certain perception among the students, however it can indicate the perceptions of the participating parts of the student populations at the two programmes. Moreover, the descriptive statistics show the results in a simple way, making the

risk of error when moving from raw data to figures very small. Thus, the results from this thesis are not generalisable, but stand for what they are; an overview of the perceptions of bioeconomy among a share of the forestry students at SLU.

External validity

Since the results from this study cannot be statistically generalised, due to the method for data collection, its' potential to be applied in the external context, in the form as evidence of the student perceptions, is questionable. However, when being seen as a pilot study for creating an overview of the student bioeconomy perceptions, it *can* be put into a bigger perspective. For instance, comparing the results from this thesis with the findings from similar studies is more intended to guide future research on the subject, rather than placing this study as equally extensive in terms of gathering student perceptions.

Reliability

To make sure that the results of this study are as reliable as possible, the theories guiding the analysis as well as the connection between research questions and study design have been thoroughly described in the previous subchapters (Riege, 2003). Moreover, the thesis has frequently been peer reviewed (*ibid.*) by a supervisor during the writing process, to make sure that the choices are as suitable as possible.

In short, using a survey is an easy and straightforward way to investigate knowledge, attitudes and values, but it comes with some prerequisites if it is to produce a satisfying result (Robson, 2011).

3.7 Ethical aspects

When handling data for real world research, there are certain ethical aspects that should be considered (Robson, 2011). One aspect is for the investigator to give as well as take (*ibid.*). Therefore, for this thesis, coffee and pastry was provided as a thank you to the respondents for the time they spent helping the study forward.

Moreover, the survey respondents were anonymous, since the survey website could not tie a certain answer to its respondent. The respondents were informed of this as well as what the survey data would be used for, on the first page of the survey (see *Appendix 1 & 2*) and had the option to not participate if they did not agree with the terms. To take the survey, they reassured that they gave their consent (by clicking “next”), and thus gave their informed consent in accordance with the Swedish **GDPR**, General Data Protection Regulation, guidelines (Government of Sweden, 2019, 1) used at SLU (SLU, 2019, 5). Moreover, each respondent had the possibility to end the survey whenever they felt like it. The only personal information collected during the research process was the email addresses of the respondents who wanted to take part in the gift card lottery. Therefore, leaving personal information was completely optional.

When it comes to the bigger picture, a publication influenced by sponsorship from the industry, such as this thesis, could pose a problem (Robson, 2011). Even though this study aims to collect the students' perspectives from a neutral point of view, the data collection was sponsored by two organisations with great interest in bioeconomy for forest production (Swedish Forest Industry Federation, 2019, 1; Östad Foundation, 2019, 1). In itself, this is not inheritably bad. However, the risk is, that research investigating the *possibilities* of bioeconomy receives more funding than research looking into the *consequences* of bioeconomy, and this could create a strong bias in *favour* of the concept.

3.8 Delimitations in the theory, method and empirics

For this thesis, several delimitations had to be made. Firstly, the theoretical background used a number of reports from the research project PerForm, which this thesis is a part of. This leads to a potential risk of the thesis being somewhat introspective in the field of bioeconomy, but also gives good arguments for why the survey is needed, as well as provides an insight into the thought process behind the development of the method used. Additionally, the major focus in the theory as well as in the empirics is put on EU and Sweden, making the questions discussed put in an international light, but not a global one. However, Europe has come a long way when it comes to sustainability research (Steurer & Hametner, 2013) and Sweden, as well as the other Nordic countries, has a big share of forest (Rytter *et al.*, 2016). This makes the focus, although limited, highly relevant.

When looking at the method used, there was a time limit on the access to the survey. The survey was only open for one month, and the possibility to come by *in situ* ran for two days at each campus. During this time, the opportunity to come by *in situ* varied among the different study years. Some classes were away on field trips, and other classes had days off. This survey thus reflects the thoughts of a certain group of forestry students in Sweden at a certain point in time and should not be generalised. Moreover, the academic understanding of sustainable development is constantly evolving, meaning that the current results correspond with the prevailing understanding of sustainable development.

In the Empirics, only a few questions from the complete questionnaire are presented, chosen based on how well they might answer the research questions. This leaves out many potential good and reflective answers. Nevertheless, the answers studied are spread out through the survey, and therefore a respondent who put little effort into the final questions might contribute with some fruitful thoughts in the beginning, and vice versa.

Finally, as a general delimitation for the entire thesis, it should be noted that the empirics derive from a survey, and with that, measuring the relevant competencies the students possess is difficult, if not impossible. Therefore, this thesis should be seen as a pilot study, which should be followed by further studies of the key SD competencies present in Swedish forestry programmes.

4 Background for the empirical study

The following chapter describes the PerForm project and the previous studies made on perceptions of bioeconomy. It further introduces the forestry education given at SLU, as well as the goals for HE in general in Sweden.

4.1 The PerForm project

In Europe, there is a need to modernise the industries to achieve sustainability (EC, 2019, 1). Aiming for a bioeconomy, interpreting the concept as covering all sectors relying on biological resources, is according to the **EC** a good strategy towards a sustainable society. Thus, a European bioeconomy strategy was set in 2012, and updated in 2018 (*ibid.*).

Due to discrepancies in the meaning of *bioeconomy* across Europe, as well as to the limited knowledge on how different forest stakeholders perceive the concept, The PerForm project was initiated by a group of scientists (PerForm, 2018), and funded by **EFI** (European Forest Institute) (PerForm, 2019, 1). The aim of PerForm is to “*better understand different disparities of national bioeconomy policies and the perceptions of a forest-based bioeconomy*” (PerForm, 2018, p. 1), with the goal to eventually create an online information platform with open-access that aims to inform stakeholders and the public about forest-based bioeconomy. As a part of this project, forest stakeholders were investigated, and a forest student survey was created by a researcher team at TESAF, since students are the ones who will implement future bioeconomy strategies. This survey was carried out in Germany, Austria, Slovakia, France, Italy, Sweden and Finland, after a translation to the main language was made and potential extra questions added in each separate country (*pers. com.*, Masiero, 2019).

4.2 Earlier studies on bioeconomy perceptions

Several studies have previously investigated stakeholder perceptions on bioeconomy, and this subchapter provides a brief overview of three studies similar, although not identical, to the one conducted in this thesis. Firstly, Stern *et al.* (2018) investigated said perceptions among four stakeholder groups in Austria; students, employees, farmers and pensioners. Their results indicate that a generally positive perception of a future bioeconomy could be expected. Furthermore, students provided a more constructive approach to discussing bioeconomy, in comparison with employees and farmers (*ibid.*). Students tended to be more interested in a bioeconomy and showcased less fear for change than the other groups. Secondly, another study investigated future professionals’, i.e. Finnish university students majoring in agriculture or forestry, perceptions of the environmental benefits and harm associated with forest management objectives in a bioeconomy context (Matthies *et al.*, 2018). From their results, the environmental concerns could be divided into the two factors “*anthropocentric concerns (i.e. concerns for humans)*” and “*biospheric concerns (i.e., concerns for the environment)*” (*ibid.*, p. 133). Both factors decreased the acceptance of production objectives, but only anthropocentric concerns remained when adding the perceived benefits (*ibid.*). Matthies *et al.* (*ibid.*) further conclude that positive consequences were more important to respondents than negative consequences, when mapping acceptance of management objectives. Moreover, these perceptions varied among perceived knowledge of the respondent. That is, the more a respondent perceived themselves to know about the management objective in question, the more he or she accepted it. Thirdly, Pätäri *et al.* (2017) found that nationality and study field had an influence on students’ perceptions of the forest industry; social science students had lower acceptance of the forest industry than natural science students, and Finnish students were more concerned with **CSR**, Corporate Social Responsibility, than Hong Kongese and Spanish students. Moreover, they

deduce that the nature of forest use in a future bioeconomy is complex and dependent on the “*perceptions, values, and levels of industry knowledge among stakeholders*” (*ibid.*, p. 201). Finally, a fourth study on bioeconomy perceptions was conducted by Hodge *et al.* (2017), which is thoroughly described in *Chapter 2*.

4.3 The Swedish forestry education

According to Skånberg *et al.* (2016), Sweden is a country with a low population in relation to the renewable resources available. The biggest share of these resources are forests, covering about 70% of Sweden’s land area (Swedish Forest Industry Federation, 2019, 3). This has an impact on the Swedish economy, since bioeconomy makes up about 5% of the country’s **GDP**, Gross Domestic Product (Skånberg *et al.*, 2016). However, a key challenge in the transition towards a growing bioeconomy in Sweden, is to increase the production of biomass without going against the country’s 16 environmental goals, as well as the SDG’s from the UN (*ibid.*).

Since the forest is one of Sweden’s biggest natural resources, some of the most important bioeconomy stakeholders are the forest stakeholders (Hodge *et al.*, 2017). These stakeholders can be categorized into the groups *ENGO’s*, *industry* and *forest owners* (*ibid.*), although one and the same person can take on several stakeholder *roles*, as discussed in *Chapter 2*. To take on some of these roles, and/or join the industry or forest owner group, a person can study forests and/or forestry in higher education. Why this is, and what programmes are of significance, will be discussed below.

4.3.1 Higher Education in Sweden

The Swedish Government describes the purpose of higher education, HE, in Sweden to be to “*contribute to learning and the improvement of the development, societal commitment and critical thinking of individuals. Education [...] is needed for a well-educated workforce and creates the preconditions for science and increased knowledge*” (Government Offices of Sweden, 2019, 2). Following this goal are the 17 universities and 31 colleges in Sweden (UKÄ, 2019, 1). Several of these universities provide programmes created with the intention to give the graduated student a vocational qualification, which can then be used as an advantage in the job market (SCB, 2019, 1). Indeed, 89% of these graduates claim that their education has been of high relevance for their work life, and even the majority, 66%, of graduates from non-vocational programmes agree with this (*ibid.*). From this, it can be concluded that HE provides a well-prepared workforce in Sweden, and that the intention of students at Swedish HE institutes many times is to improve their own employability.

4.3.2 Forestry Education at SLU

SLU is, in opposition to the other academic institutions in Sweden, a university situated below the Ministry of Enterprise and Innovation (ESV, 2019, 1). The appropriation directions from the ministry creates together with the Law of Higher Education the basis for of the academic work at SLU (SLU, 2019, 5). To live up to the demands stated by these two requirements, SLU has for instance integrated the global SDG’s of Agenda 2030 into their work (SLU, 2019, 4). Concerning the forestry education, two of the sub-goals of the SDGs are of particular importance at SLU: *goal 4.7*, which states that all learners should acquire the knowledge needed to promote sustainable development, and *goal 15.2*, that claims that implementation of sustainable forests management should be promoted (UN, 2019, 2; UN 2019, 3). In their strategy, SLU intend to follow up these goals by providing educational forestry programmes as well as doing research in the area (SLU, 2019, 6). The programmes offered from bachelor level are the Forestry Bachelor program and the Forestry Master programme, which are described in Table 9 below.

Table 9. Learning objectives for SLU's forestry programmes

	Forestry Bachelor programme	Forestry Master programme
Time:	3 years	5 years
Aiming to prepare the students for:	Working in the industry	Working in the industry, or pursuing a science career
Education structure:	2 years base level 3 rd year choose courses for themselves	2 years base level, From 3 rd year choose a profile, or alternatively create their own combination (SLU, 2016b)
Competencies required for graduation:	Information-knowledge and understanding of the forestry practice, its prerequisites, functions and how it interacts with the environment and society (SLU, 2016b)	Knowledge and understanding about the many branches of forest science and the prerequisites for the forest sector (SLU, 2016b)
	Critical thinking (SLU, 2016a)	Critical thinking, and analysis of sustainable development in the forestry sector
	Independent problem-solving	Independent problem-solving
	Holistic thinking (science, society, economy, environment, ethics) for forest resource use	Holistic thinking (science, society, economy, environment, ethics) for forest resource use
	Be able to collaborate with other people	Be able to collaborate with other people
	Identify their own need for further knowledge (SLU, 2016a)	Identify their own need for further knowledge
		Global/international mindset (SLU, 2016b)

In Table 9 above, information about the Forestry Bachelor and Master programme at SLU is given, which was collected from the programme curriculums. Currently, during the spring semester of 2019, 145 students were registered at the forestry bachelor programme, and 271 at the forestry master programme (*pers. com.*, Eriksson, 2019), making up a total of 416 students. For the master programme, the students can during their third year choose a profile from; *Forest ecology and management*, *Forestry around the Baltic Sea*, *Forest Industrial Economy*, *Forest Raw Material Management* and *Fish and Wildlife Management*, or create their own profile by choosing certain courses at masters' level (SLU, 2019, 2). Although the master programme has gone through some changes during the last decade (*cf.* SLU, 2019, 2), the requirements to graduate in terms of acquired SD competencies do not differ at a significant level between the investigated study years, since SLU has a responsibility to implement these competencies in all courses offered at the programmes (SLU, 2019, 5).

5 The empirical study

This chapter presents the empirical results from the study, starting with General results from the collection process and then moving on to the chosen answers for analysis, divided into Fixed alternatives for answers and Open-ended questions.

5.1 General information and observations

As a participant in the PerForm project, the author of this thesis had access to the link for participation in the student survey, but not to the database of the collected answers. Thus, the responses shown in this thesis are the ones that by the survey programme were marked *completed* and sent to the author (*pers. com.*, Pülzl, 2019). However, in the survey, it was possible to skip certain questions, which explains why the total nr of answers per question varies, see Table 10.

Table 10. The variation in responses to the survey questions studied

Question	S11	S13	S24	S25	S37	S38	S61	S64	S65	S71	S72
Nr of responses	105	96	91	100	99	83	106	106	106	94	90

Above, the number of responses per survey question studied is presented, to help interpret the results further on. To see the full questions, see Table 3. The non-responses will henceforth be marked as 6 or NA, both of them indicating “no answer”. Additionally, In Table 11 below, the study levels of the respondents are presented.

Table 11. The study levels of the respondents

Year	Respondents/year	Enrolled at Bachelor/Master*	Bachelor/masters' level	Total nr of respondents/level
1	37		32/5	Bachelor
2	28		27/1	Bachelor
3	13		13/0	Bachelor
4	3		0/3	Masters'
5	25		0/25	Masters'
*(nr bachelor respondents)/ (nr master respondents)				n = 106

As shown in Table 11, the number of respondents vary between the study years, the biggest difference being between 1st year (37 respondents) and 4th year (three respondents). Year one to three was counted as bachelor level for both bachelor and master students, since these are the years both programmes provide the bachelor, mandatory courses. During their two final years, the master students have the possibility to choose some courses for themselves, studying at masters' level (cf. *Chapter 4*). In Figure 9 below, the respondents are shown in relation to the total nr of students enrolled at the two forestry programmes at SLU.

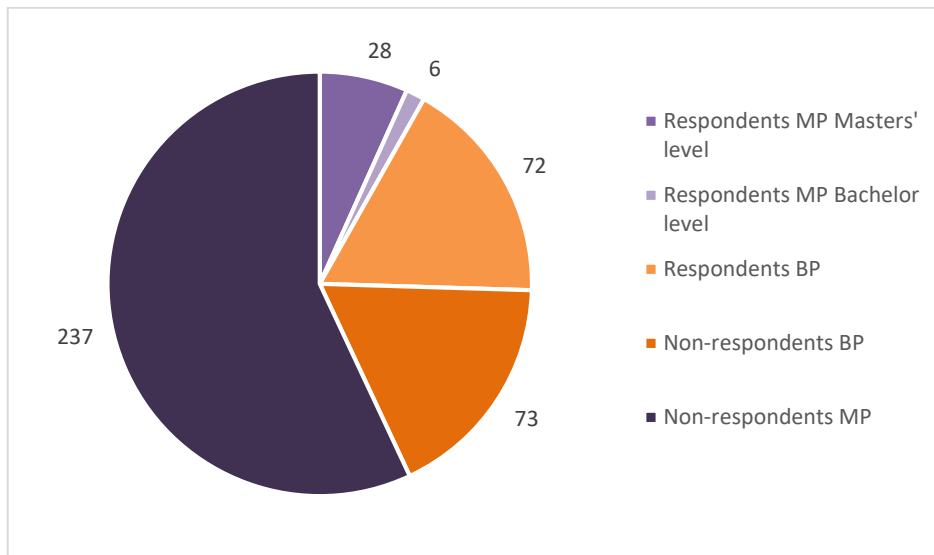


Figure 9. Number of responding students in relation to the total number of students at the master programme (MP, masters' and bachelor level) and bachelor programme (BP).

As Figure 9 shows, there were **34** respondents who were enrolled at the forestry master programme, which makes up 12.5% of that total population of 271 students, and **72** at the forestry bachelor programme, corresponding to almost 50 % of the total student population of 145. Due to this unevenness in programme-related responses, a comparison was decided to only be made between the study levels, and not between programmes as well, which was an initial goal. In total, 25 % of the total number of forestry students at these two programmes participated in the survey.

The respondents expressed that they participated in the survey due to three main reasons:

- They wanted free coffee and pastry (most common)
- They wanted to participate in the gift-card lottery (pretty common)
- The wanted to contribute to research on bioeconomy and sustainability (common in combination with 1 and 2, rare on its own)

These reasons could be an interesting notion for future student research. Moreover, the ages of the respondents ranged from 19 to 59 years (Figure 10), with a mean value of 25 and a median at 24.5 years.

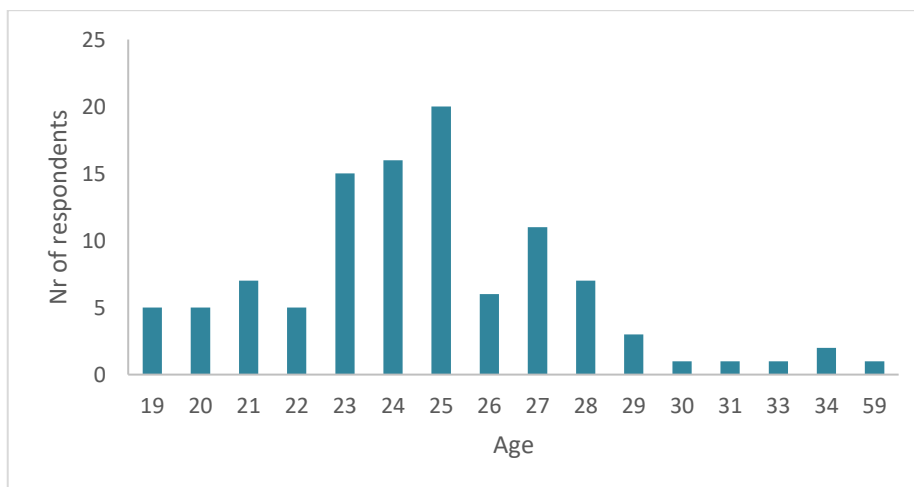


Figure 10. Age variation of the respondents

Figure 10 above shows the age variation of the respondents, showing a spread of age, although the majority of the respondents were between 23 to 25 years old.

Fixed alternatives for answers

For the survey questions S11, S24, S25 and S37 the answer options consisted of fixed alternatives. In the following subchapters, these answers are presented separately in accordance to their corresponding research question.

Open-ended questions

Four of the questions analysed for this thesis were open-ended (S13, S38, S71 and S72), meaning that the respondent was free to type whatever they wanted to answer the question. Below, these answers are presented in the form of *word clouds*, to give an overview of the most frequently used words in these answers. Note, however, that these word clouds derives from a translation from Swedish to English, meaning that they are not the *exact* words of the respondents, but rather an estimation of what the respondent would have answered in English. Furthermore, due to a malfunction in the program used, not all words without intrinsic value, as described in *Chapter 3.5.3*, could be removed.

5.2 Bioeconomy according to forestry students

This subchapter shows the results relevant for research question 1; “*What is bioeconomy, according to Swedish forestry students?*”. The first survey question regarding research question 1 is S11, which asked if the students had previously heard about bioeconomy. The results are shown in Figure 11 below.

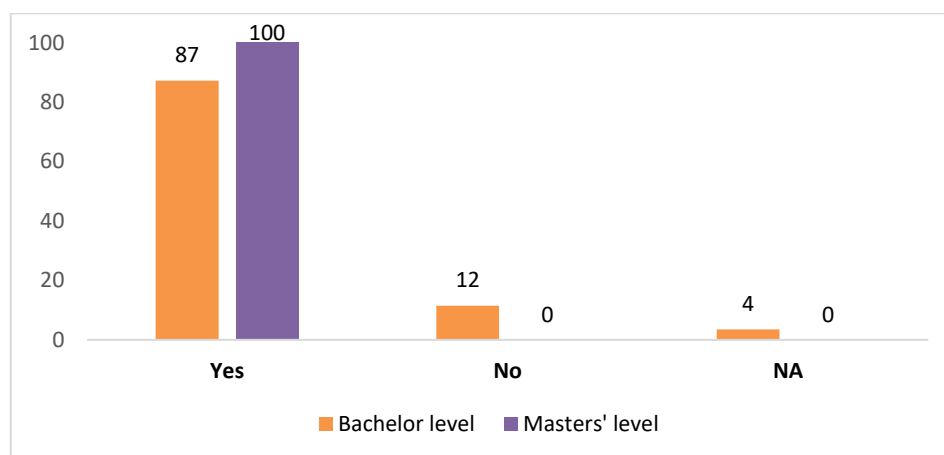


Figure 11. Answers to S11, “*Have you ever heard about bioeconomy or bio-based economy?*”, divided by study level and in percentage of the total number of respondents in each category. NA indicates “no answer”.

In Figure 11 above, the answers for S11 are presented per study level and as a percentage of the total number of respondents studying at bachelor (year 1 to 3) and masters’ level (year 4 and 5). This was done since the number of respondents per study level were different (78 and 28, respectively), and therefore it was easier to compare the levels this way. The results show that the majority of the responding students had heard about bioeconomy before the survey took place (87% of students at bachelor level and 100% at masters’ level). In Figure 12 below, their interpretations of what bioeconomy is, are presented.

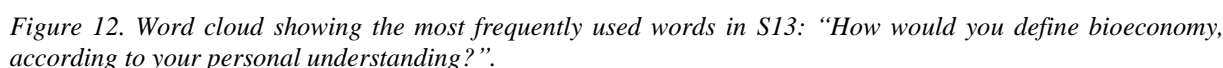
[illegible]

Figure 13. Word cloud showing the most frequently used words in S72: "What competencies do you believe are of importance within the forest-based bioeconomy?"

28

bioeconomy. Figure 13 above shows an overview of the responses. Compared with Figure 12, there are fewer words in Figure 13, indicating that the answers to question S72 were more coherent than the responses to question S13. However, there were 15 more respondents to S13 compared to S72 (see Table 10), meaning that the increased coherency in S72 could depend on less chance for variation as well as a stronger shared view on important competencies.

In short, the most frequently used words were *knowledge*, *re-thinking*, *understanding*, *development* and *innovative*, indicating that the respondents perceive bioeconomy as a concept where factual competence and/or the ability to be creative are of importance.

5.3 Students' perception of the forests' role

To be able to answer research questions 2a and 2b; “How do the students perceive the forests' role for the Swedish bioeconomy? Does this differ across age and/or years of study?”, survey questions S37 and S38 were studied, and the results are presented below (Figure 14 and 15).

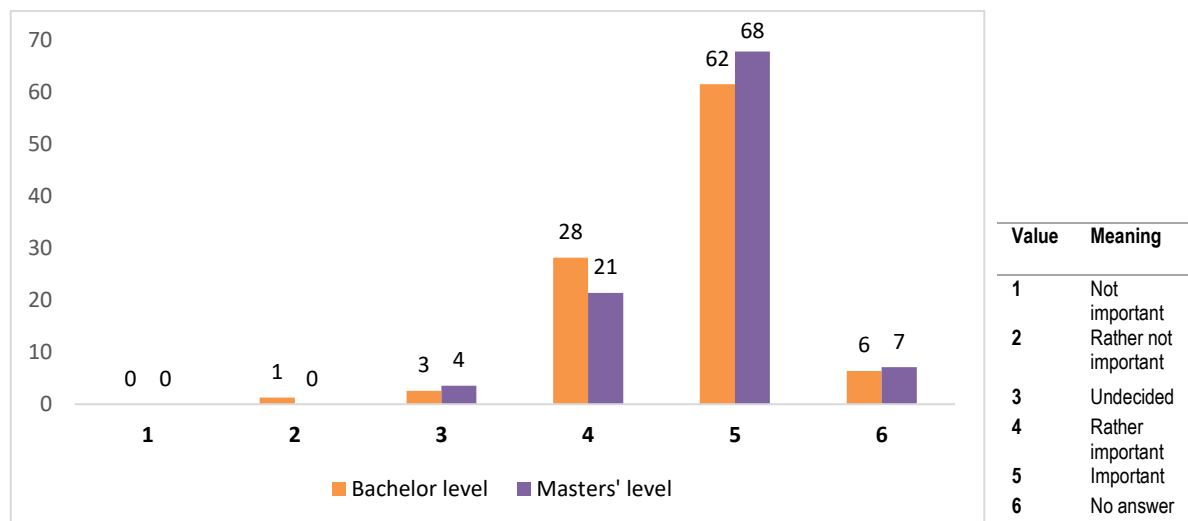


Figure 14. Answers to S37, “How relevant is the current role of forests within bioeconomy in the country where your academic program is offered?”, divided by study level and in percentage of the total number of respondents in each category.

Figure 14 above illustrates the importance of the forest in Sweden according to the respondents. 68% of the respondents at masters' level (year 4 and 5) attributed the forest an *important* role within the bioeconomy, compared to 62 % of the respondents at bachelor level (year 1 to 3). In total, 90 % of all the respondents perceived the role of the forest in Sweden to be *rather important* or *important*. Only 1% of the respondents at bachelor level, and 0% of the ones at masters' level, expressed that the forest was *rather not important*. No respondent suggested that the forests' role was *not important*. Figure 15 below illustrates the words most frequently used when respondents described why they assigned the forest the role they did.



Figure 15. Word cloud showing the most frequently used words in S38: “Please motivate your choice by reporting the main reasons/arguments for attributing such a role”.

Figure 15 above shows the most common words used when describing why or why not the forests play an important part in the Swedish bioeconomy. From this word cloud, it is difficult to draw a full motivation, therefore this question was further analysed in *Chapter 6* to understand why the majority of the respondents thought of forest as a way to create a bioeconomy.

5.4 Students' perception of higher educations' role

Survey questions S24, S25 and S71 regarded research question 3 (the respondents' perceptions on their own education), asking "*How much are you satisfied with the extent to which bioeconomy is currently addressed within your programme?*" (S24), "*Do you think it is necessary to address bioeconomy more in your University's curricula?*" (S25) and "*What obstacles do you see for the forest-based bioeconomy in today's education?*" (S71). The answers are shown in Figure 16, 17 and 18 below.

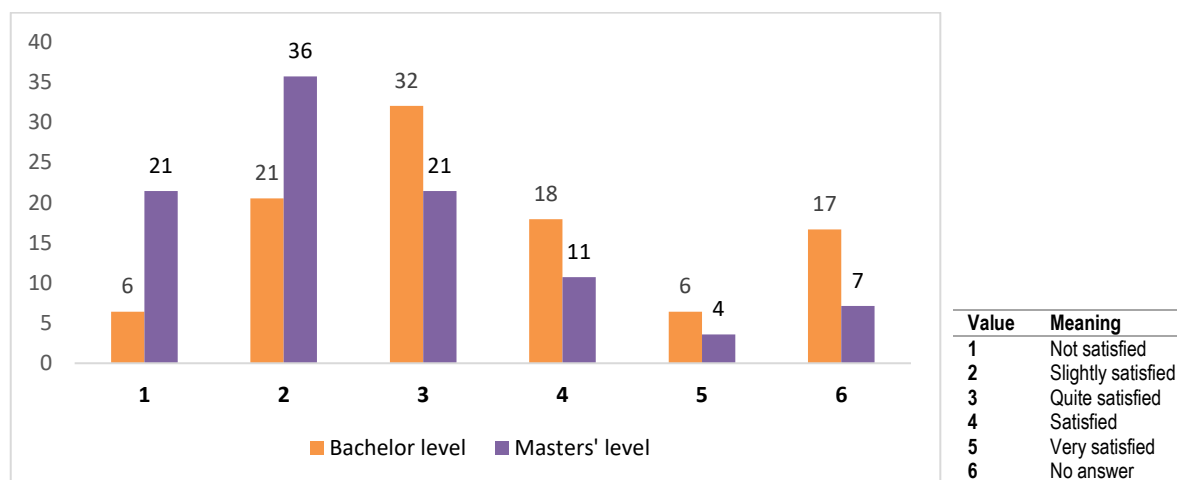


Figure 16. Answers to S24, “How much are you satisfied with the extent to which bioeconomy is currently addressed within your programme?”, divided by study level and in percentage of the total number of respondents in each category.

In Figure 16 above, the answers divided by bachelor (year 1 to 3) and masters' (year 4 and 5) level are shown. The most frequent answer was that the respondents were *quite satisfied* with the extent to which bioeconomy was addressed within their university curriculum (26.5 % of the total respondents). However, a higher percentage of the respondents at masters' level were *not satisfied* (21%) or only *slightly satisfied* (36%) with how bioeconomy has been addressed, compared to the respondents at bachelor level (6% and 21% respectively). Figure 17 below shows whether the respondents thought it was necessary to address bioeconomy more in their university's curricula.

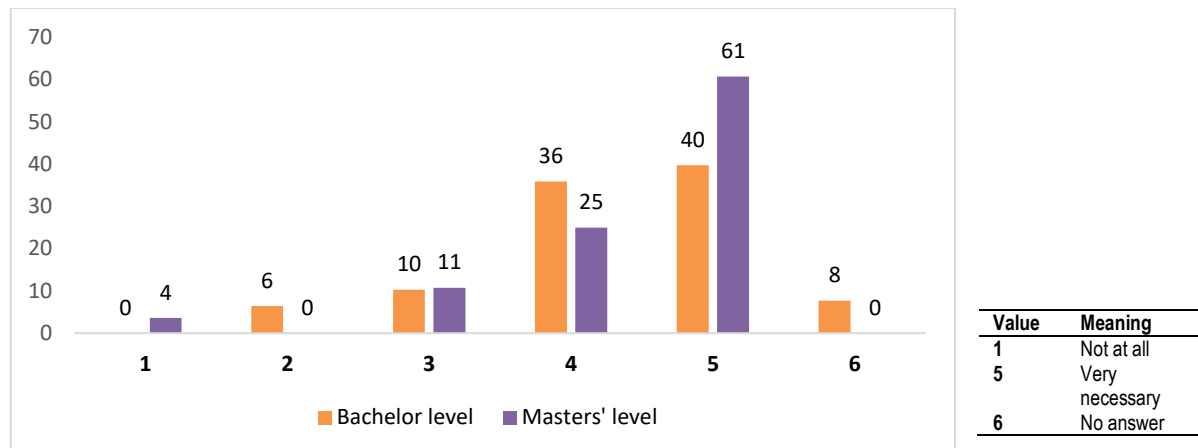


Figure 17. Answers to S25, “Do you think it is necessary to address bioeconomy more in your University’s curricula?”, divided by study level and in percentage of the total number of respondents in each category.

Figure 17 above shows the answers to question 25 divided by study level. A higher percentage of the respondents at masters' level answered that it is *very necessary* to address bioeconomy more, compared to the respondents at bachelor level. The majority of the latter respondents were divided between rating 4 or 5 on the scale (36% and 40 % respectively), showing that these respondents think it is *necessary* or *very necessary* to address bioeconomy more. Moreover, 78% of the total respondents answered 4 on the scale 1-5, meaning that only 15% of the masters' and 16% of the bachelor level respondents answered 3 or lower. The potential obstacles in the way of addressing bioeconomy more in the programmes are presented in Figure 18 below.



Figure 18. Word cloud showing the most frequently used words in question S71: “What obstacles do you see for the forest-based bioeconomy in today’s education?”.

The word cloud in Figure 18 shows the most frequently used words for question S71. In the illustration, it is difficult to see any words standing out on their own, however *forest*, *forestry*, *knowledge*, *teachers* and *education* seem to have been used a bit more than the others. To understand what these words indicate, a further analysis was made, see *Chapter 6*.

5.5 Overview of numerical survey data

To give an easy overview of the results from the *fixed alternatives for answers*, a summary is shown in Table 12 below. When calculating the median and mean value, the answers indicating no answer (that is, value 6 in the earlier figures) were excluded.

Table 12. Measures of central tendency for the survey questions with fixed alternatives for answers

Question	Respondents	Median	Mean
S24	Year 1-3	3 (Quite satisfied)	3.0 (Quite satisfied)
“How much are you satisfied with the extent to which bioeconomy is currently addressed within your program?”	Year 4-5	2 (Slightly satisfied)	2.3 (Slightly satisfied)
	All	3 (Quite satisfied)	3.2 (Quite satisfied)
S25	Year 1-3	4 (Necessary)	4.2 (Necessary)
“Do you think it is necessary to address bioeconomy more in your University’s curricula?”	Year 4-5	5 (Very necessary)	4.4 (Necessary)
	All	4 (Necessary)	4.2 (Necessary)
S37	Year 1-3	5 (Important)	4.6 (Important)
“In your opinion, how relevant is the current role of forests within bioeconomy in the country where your academic program is offered?”	Year 4-5	5 (Important)	4.7 (Important)
	All	5 (Important)	4.7 (Important)

In Table 12, there is a difference between bachelor (year 1 to 3) and masters’ level (year 4 and 5) when looking at the median values for question S24 and S25. In general, the respondents at masters’ level seem less satisfied with the extent to which bioeconomy has been addressed within their education, and also believe it is very necessary to address the concept more. This also applies for the mean values for question S24. However, when looking at the mean values, the answers at masters’ and bachelor level are more coherent for question S25.

6 Analysis

This chapter provides the analysis, done by using the conceptual framework from Chapter 2, the empirical background presented in Chapter 4, as well as the empirical data from Chapter 5. Chapter 6.1 to 6.3 concerns research question 1 to 3, and Chapter 4 provides the summarisation of goals, curriculums and responses asked for in research question 4.

In general, the analytical coding process using the theory from Graneheim and Lundman (2004) went smoothly, although it was time-consuming. The results are based on a thorough interpretation process, aiming to highlight the variation in the answers in a summarised way.

6.1 Bioeconomy according to forestry students

This subchapter focuses on the survey questions S13, “How would you define bioeconomy, according to your personal understanding?”, and S72, “What competencies do you believe are of importance within the forest-based bioeconomy?”, both relevant to answer research question 1; “What is bioeconomy, according to Swedish forestry students?”. In the end, this will be put together with question S11, “Have you ever heard about bioeconomy or bio-based economy?”, to get an as good understanding of what the respondents think about bioeconomy, as possible. Below, the framework used for the analysis is presented (Figure 19).

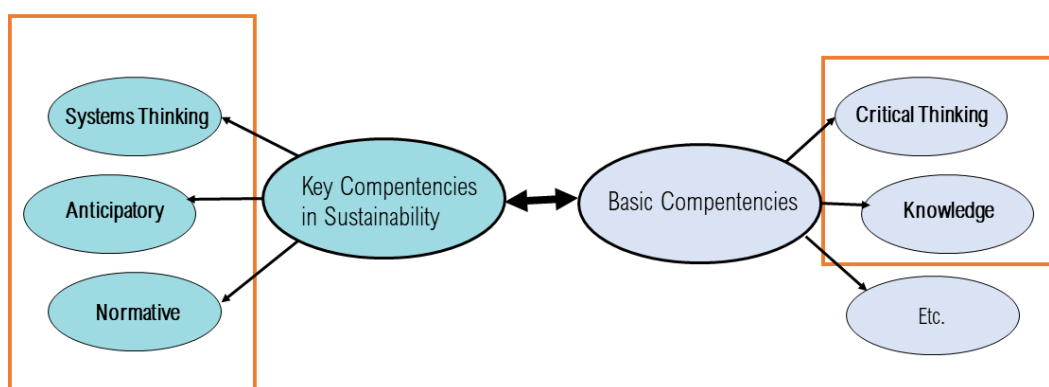


Figure 19. The SD competencies relevant to research questions 1-3b, marked with boxes. Based on the framework by Wiek et al. (2011).

Figure 19 shows the SD competencies of importance for research question 1 to 3b. As a reminder, *Systems Thinking Competence* is the ability to analyse systems across e.g. society, environment and economy at different, local to global, scales (Wiek et al., 2011). *Normative Competence* is the ability to map sustainability values and goals, including assessing unsustainability, and create visions for the systems investigated. Finally, *Anticipatory Competence* is the ability to create pictures of the future related to sustainability issues (ibid.). With the research question investigated in this subchapter, how the respondents define the concept is based on what they already know, which is linked to the rudimentary competence *Knowledge*, and whether and how they put that into a bigger perspective is linked to *Critical Thinking*, as well as the three above described *Key Competencies* (ibid.). In Figure 20 below, the respondents' definitions of bioeconomy are summarised. In Table 12, their thoughts on what competencies are of importance within the bioeconomy are presented.

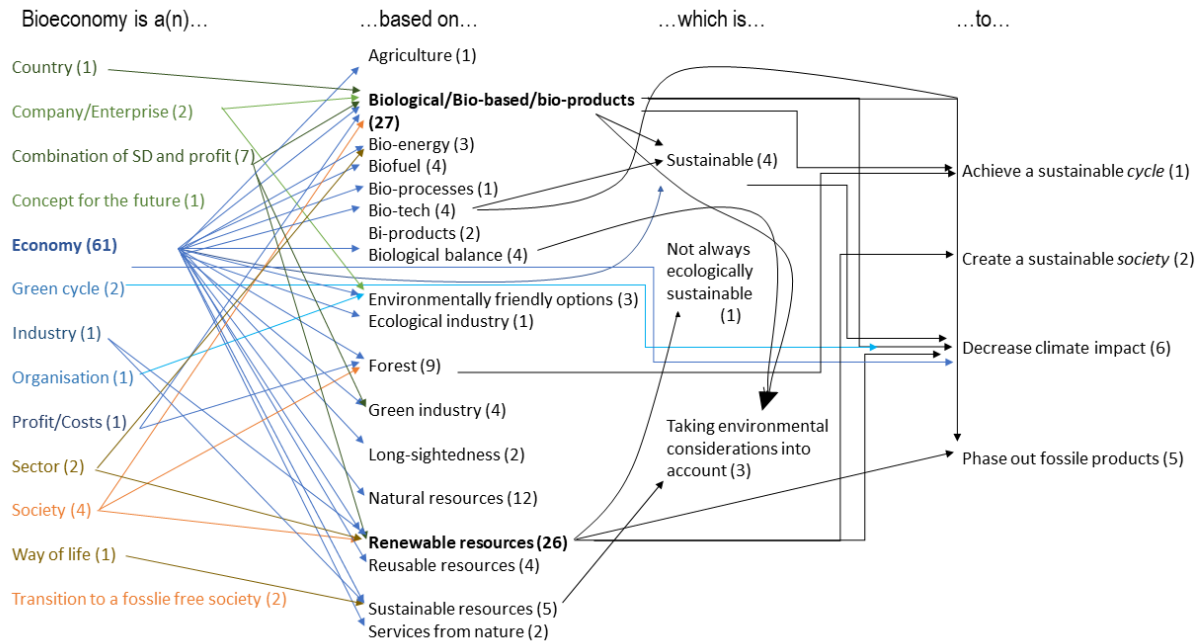


Figure 20. An overview of the responses to question S13: “How would you define bioeconomy, according to your personal understanding?”, presented by expression(nr), where (nr) represents the number of respondents using the expression in their answer.

In Figure 20 it is clear that what bioeconomy is, as well as its purpose, varies between the respondents. In total, 96 of the 106 respondents answered this survey question (question S13). In their responses, they had the opportunity to answer as freely as they wanted, and therefore one respondent could mention multiple parts of each column (a column being the words underneath *Bioeconomy is a(n)*, *based on*, *which is*, or *to*). Usually, a respondent used one or two of the expression types in the “*Bioeconomy is a(n)*”-column, and then proceeded to use multiple expressions in the remaining columns. The most frequent answer seen in Figure 20 is that bioeconomy is an *economy* (according to 61 respondents) that is based on *biological/bio-based/bio-/ products* (27 respondents) or *renewable products* (26 respondents). After this, the number of times the same expression is used drops drastically, being mentioned between 1 (e.g. *Agriculture*) to 12 times (e.g. *Natural resources*).

Looking at the SD competencies highlighted in Figure 19, we can in Figure 20 see some variation in how often these different SD competencies are indicated. The *Knowledge* about bioeconomy varies as much as the answers vary in general, something that is not surprising since the concept itself has not been defined in the scientific community yet. When it comes to *Systems thinking competence*, the expression *Combination of SD* (Sustainable development) *and profit*, as well as the reoccurring mentioning of *society* in different columns, suggest that some of the respondents immediately put bioeconomy into a bigger context than simply the bio-based industry/economy. Likewise, when using *industry* or *economy* as a stepping-stone, the ideas of a *green industry*, an industry/economy based on *biological balance/environmentally friendly options* which is *taking environmental considerations into account*, show a perspective of environmental consciousness, something bigger than a financially sustainable economy on its own. For the *Anticipatory competence*, definitions like *transition to a fossil free society*, a *concept for the future*, based on *long-sightedness* to *phase out fossil products/create a sustainable society* imply that some of the respondents have a long-term outlook on bioeconomy. However, these respondents do not make up a big share of the total respondents, since only two of them mentioned *long-sightedness*, and the other definitions listed had 1 to 5

respondents. Finally, for the *Normative competence* (Wiek *et al.*, 2011), the respondents are naming several SD goals and visions (*phase out fossil fuels, using renewable/reusable/bio-based resources, decrease climate impact*). Table 13 below illustrates the important competencies within a bioeconomy, according to the respondents.

Table 13. The coded answers from survey question S72, (competencies of importance within a bioeconomy)

Code	Frequency	Explanation	Related SD competence
Being open-minded	8	Having trust in others, showing respect	
Communication skills	8	Be able to explain the problems, collaborate with/inspire others, being diplomatic and/or provide social support	
Critical thinking			Critical thinking
Cycle thinking	2		
Dedication	3	Seeing the product chain as a loop, “zero-waste”-mentality	Systems thinking
Don’t know	15	Being ambitious and/or determined, showing diligence, being optimistic	Normative
Efficiency	3		
Environmental thinking	9	Providing efficient forest management, logistic mindset	
Flexibility	5		Systems thinking
Future thinking	2	Being able to adapt to change	
Global mindset	4	Thinking in future scenarios	Anticipatory
Holistic thinking	3	Collaborating over borders, thinking in a global perspective	Systems thinking
	16	Seeing the “whole picture”, both the production’s, the ecology’s and our society’s part, a transdisciplinary mindset	Systems thinking
Innovation			
Interest	14	Creativity	Normative
Knowledge	7	Having an interest/curiosity for the topic	
	27	Possessing knowledge about all parts of bioeconomy/detail knowledge about certain areas	Knowledge, Systems thinking
Logical thinking			
Marketing skills	2	Rational thinking/ Common sense	
Problem-solver	3	Being able to sell the concept of bioeconomy	
Recruitment skills	2		
Re-thinking	2	Recruiting the right people	
Understanding the forest as a resource	11	Being able to “think new” and break norms	Normative
Understanding financial incentives	9	Provision of raw materials, seeing potential products	Normative, Systems thinking, Anticipatory
	2		Systems thinking
Unclear answer	10	Answers reflecting other questions than the one asked	

In Table 13 above, the codes for survey question S72 are presented, with the total number of times they were used shown within brackets. The three most frequently mentioned competencies within the forest-based bioeconomy are highlighted, which are *dedication*, *holistic thinking* and *knowledge*, the latter being the most popular. The SD competencies from Figure 19 indicated in

the responses that are listed in the right column. However, several other competencies, not easily put within the categories chosen from Wiek *et al.* (2011), were discovered as well. These include the ability to have *good communication skills* (8), being *open-minded* (8), a *problem solver* (2) and having the ability to adapt to change (*flexibility*, 2), as well as possessing the qualities of *logistical thinking* (2) and *efficiency* (9). For further reflection on this, see *Chapter 7.1*.

When looking at both Figure 20 and Table 13, certain discrepancies in the answers can be found. Some respondents are eager to express the importance of bioeconomy as a cornerstone for sustainable resource use in a materialistic way, where an efficient and logistical mindset is of importance to make the best use of the resources. At the same time, a smaller share of the respondents focuses more on other services from nature, and/or the environmental impact the increased bio-based resource use would bring. However, despite Figure 20 being rich in different expressions, a theme can be deduced. To many, bioeconomy seems to be a way to use the economy or industry based on biological (/natural/bio-based/etc.) resources to achieve sustainability, be that in a *country* or a *society*, or merely as a *way of life*. Linking this with the competencies of importance in Table 13, bioeconomy is further a concept associated with possessing the knowledge to think outside the current industry frame and being driven and charismatic enough to see a conceptual implementation through.

According to Figure 11 in *Chapter 5*, 87 % of the respondents at bachelor level and 100 % of the respondents at masters' level, in total 93 % of all respondents, had heard of bioeconomy before. Thus, in conclusion, a majority of the respondents are familiar with the concept, although what it means is still unclear. However, the abilities of being critical, dedicated and innovative (*Normative competence*), knowledgeable (*Knowledge*), able to envision future scenarios (*Anticipatory*) and seeing the whole picture (*Systems thinking*) appears to be of importance to the respondents, and by mentioning them, these are competencies somewhat indicated by the respondents themselves.

A side-note to keep in mind for the next subchapter is that several students in their definitions of (Figure 20) and competencies linked to (Table 13) bioeconomy mentioned *forest* as an important resource.

6.2 Students' perception of the forests' role

This subchapter seeks to answer research questions 2a and 2b; "*How do the students perceive the forests' role for the Swedish bioeconomy?*" and "*How does this differ between bachelor and masters' level?*".

In Figure 19 in the previous subchapter, the SD competencies of importance for research question 2a and 2b are presented. In *Chapter 5.3* (Figure 14), the respondents' rating of the forests' importance for the national bioeconomy are illustrated. Below, Table 14 shows the motivations for these ratings, coded into categories.

Table 14. The coded motivations for rating the forests' role (scale 1, not important, to 5, important) in the Swedish bioeconomy (survey question S38). The number in front of the brackets is the rating given, and the number within is the usage frequency for the motivation at that rating

Coded motivation from S38	Used for rating(frequency) in S37	Related SD competence
A renewable resource	3(1)	Systems thinking
Big bioeconomic resource	5(9)	Systems thinking
Big export value	5(6), 4(3)	Systems thinking
Big financial resource	5(9), 4(4), 3(1)	Systems thinking
Big natural resource	5(12), 4(1)	Systems thinking
Big renewable resource	5(7), 4(1), 6(1)	Systems thinking
Consumers need to be informed about bioeconomy	6(1)	Normative
Don't know	6(1)	-
Forest can replace fossil products	6(2), 5(7), 4(2)	Anticipatory
It will play a big part in the future	3(1)	Anticipatory
More investments and/or incitements needed	6(1), 5(1), 4(4)	Normative, Critical thinking
More sustainable management needed	4(2)	Normative
Needs to be more important than it is today	4(1)	Anticipatory
Not enough action taken yet	3(1)	Anticipatory, Normative, Critical thinking
Sweden is at the forefront (of SD research, bioeconomy)	4(3)	Systems thinking
Swedish bioeconomy = Swedish forest sector	6(1), 5(1)	Systems thinking
Sweden has high goals for the bioeconomy	6(1)	Normative
Sweden is a safe place where long-term investments in innovative solutions can be made	5(1)	Systems thinking
The forest industry here has come far	6(1) 5(3), 4(4)	Normative
The forest has many different uses	6(1), 5(5), 4(2)	Systems thinking
The forest material has many properties	6(1), 5(12), 4(4)	Systems thinking
The forest will not suffice to replace all fossil resources	6(1), 4(1)	Normative, Systems thinking, Critical thinking
The forest resources can be used in a better way.	4(1)	Normative
Unclear answer*	5(2), 4(1)	-
Use of biobased materials is increasing	4(1)	Anticipatory
We can lead sustainable development (/bioeconomic development) globally (/in europe) with our forest	5(5)	Systems thinking
We should use our plantation forest since we have a small share of natural forest (compared to others)	5(1)	Systems thinking

Table 14 shows the motivations behind the ratings given for question S37, where the ratings are shown in front of the brackets, and the number of times the motivation was used for the rating is

shown within the brackets. As a reminder from *Chapter 5*, rating 1 means that the respondent see the role of the forest as *not important*, rating 2 equals with *rather not important*, rating 3 means *undecided*, rating 4 stands for *rather important*, rating 5 *important*, and rating 6 shows the *no answer-responses*. *Unclear answer* represents the three answers (two for rating 5 and one for rating 4) that were too abstract to categorise.

The general pattern seen is that a grand majority of the respondents (90 %, according to Figure 14 in *Chapter 5*) rated the forests' role as *rather important* or *important*. The most popular motivations behind these are that the forest is *a big financial and/or natural resource*, that it can *replace fossil products* and that the *forest material has many properties*. Furthermore, the ideas that *the forest industry here has come far*, that *Sweden is at the forefront of SD and bioeconomy research* and can *lead sustainable development globally with our forests* reoccurred in the ratings of 4 and 5. This reflects an optimistic view on the national forest industry. Nonetheless, for the rating 4 (*rather important*) there are, besides the motivations above, arguments claiming that the forest is well on its way to become important but is not quite there yet, such as; (the forest) *needs to be more important than it is today*, *the forest resources can be used in a better way*, and *use of biobased materials is increasing*.

Moreover, the motivations behind choosing *undecided* (3) sometimes overlapped with the ones given for rating 4 or 5. However, three arguments stood on their own, claiming that the forest is *a renewable resource*, that *it will play a big part in the future* and *not enough action has been taken yet*. This could be seen as answers reflecting an uncertainty when it comes to the current role of the forest, as well as a critical perspective when it comes to actions taken.

When looking at the SD competencies in Table 14, all of the competencies but *Knowledge* from Figure 19 are listed. Knowledge is of course needed to argue for the ratings given, however, since survey question S38 regarded the respondents' perception of the forests' *role* in a bioeconomy, a very subjective question, there is no right or wrong and therefore no indication that one type of answer reflects a higher level of knowledge than another. Therefore, *Knowledge* should be seen as being present in all answers (except, of course, the one stating *don't know*). Furthermore, the indications for *Anticipatory* competence is found in the answers regarding what role the forest *will* play in the future, where the answers point to the forest importance increasing in the future. In contrast, *Systems thinking* competence is indicated in answers expressing the current importance of the forest resource. Finally, suggestions of *Normative* competence and *Critical thinking* appear in answers stating an evaluation of some sort, regarding matters that *have been* or *needs to be* done, such as, for instance, *the forest resources can be used in a better way*, or *more investment and/or incitements needed*.

In total, 99 respondents gave a rating of the forests' importance (S37, see Figure 14), but only 83 respondents gave a motivation. Note, therefore, that not all ratings have a motivation, and not all respondents who gave a motivation gave a rating (1-5) but instead skipped that question (6). This leads to some gaps in this overview. For instance, the motivations behind choosing *rather not important* (2 respondents) are lacking. Nonetheless, the findings in Table 14 together with the results in *Chapter 5* as well as in *Chapter 6.1* indicate that the respondents perceive the forests' part in a bioeconomy to be of importance, in terms of being a suiting resource provider for sustainable development. How the respondents further perceive their own education on the subject, will be analysed below.

6.3 Students' perception of higher educations' role

This subchapter summarises the information needed to answer research questions 3a and 3b; "*How do the students perceive the higher educations' role for the Swedish bioeconomy?*" and

“How does this differ between bachelor and masters’ level?”. For these research questions, survey questions S24, S25 and S71 were studied. These questions consider the SD competencies shown in Figure 19, as the previous subchapters.

The answers to S24 and S25 are shown in Figure 16 and 17 in *Chapter 5*, and in Table 15 below, the obstacles for the forest-based bioeconomy found in today’s education, according to the respondents, are listed (survey question S71). In total, S24 had 91 respondents, and S25 and S71 had 100 and 94 respondents, respectively.

Table 15. Coded answers to survey question S71; “What obstacles do you see for the forest-based bioeconomy in today’s education?”

Code	Frequency	Explanation	Related competence
Climate change	1		Systems thinking
Concept is...	16	Biased, unclear or not used	Normative, Critical thinking
Conservatism	17	Traditions in the way of progress	Normative, Anticipatory
Don’t know	6		
Forestry Industry Struggling	14	Economy, high costs, fossil competition, poor understanding of the industry from the outside	Systems thinking
Ignorance	19	Insufficient knowledge among students, teachers, stakeholders and societ	Knowledge, Systems thinking
Insufficient Education	30	Teacher resources insufficient, bad planning, industry influences the programme	Normative, Systems thinking, Critical thinking, Anticipatory
Lack of Dedication	15	No follow-through or incentives for change, uninteresting topic	Normative
Lack of Innovation	9	Fear of failure, technology underdeveloped	Normative
Land use planning	5	Competing land-uses, lack of resources, lack of forest	Systems thinking, Critical thinking
No obstacles	6		
Politics	8	Bureaucracy, too much/too little regulation	Normative
Production/ Environment divide	10	Division among stakeholders, production-oriented people/anti-forestry people	Normative, Systems thinking
Bigger perspective missing	10	Other/whole perspective(s) absent, no societal connection	Systems thinking

In Table 15, *insufficient education* is shown to be the most frequently mentioned obstacle for bioeconomy in today’s education, having 30 respondents using it as an argument. This definition is based on answers where the *teacher resources* are *insufficient*, the programmes or courses are poorly planned (*bad planning*) or where critique is made towards the programmes being so highly influenced by the industry (*industry influences the programme*). The answers mentioning *insufficient teacher resources* refer to either the assertion that teachers do not have enough time to go into the depths of bioeconomy, or that there is a very limited number of teachers possessing the right knowledge in the field. Moreover, three respondents stated that the programmes are *influenced by the industry* and questioned whether it is wise to let the programmes continue to focus on what the current industry wants, instead of looking into what forest management we could be needing tomorrow. Likewise, some of the answers behind *bad planning* questioned the

programmes' lack of future perspectives. Additionally, those respondents also argued that bioeconomy should be more involved in current courses, as well as claiming that the forestry programmes needs to be attractive to a larger audience than they are today.

The next most frequently mentioned obstacle, *ignorance*, can easily be linked to the SD competence *Knowledge* (Figure 19). That is, 19 respondents appear to experience insufficient knowledge about bioeconomy among their fellow students and themselves as well as with teachers, stakeholders and/or society (Table 15). *Ignorance* is also linked to the *Systems thinking* competence, which is present in answers regarding other and bigger perspectives than simply the forest industry.

Anticipatory competence is indicated in the two answers *conservatism* and *insufficient education*. The former is the third most frequent answer, and it reflects anticipatory competence since the respondents envision a sustainable future and imagine that *traditions* will stand *in the way of progress* towards that future. In the latter answer, the respondents ask for an education planned for tomorrows' needs, as previously discussed, which also has to do with said competence. Furthermore, *Normative* competence and *critical thinking* are competencies shown in answers questioning the current state of the forest industry and/or bioeconomy. They both appear in the answer claiming that bioeconomy as a concept is *biased, unclear or not used*, as well as in the one stating that the education is *insufficient*. Additionally, critical thinking is, together with systems thinking, present in the answer *land use planning*, an argument stating that *competing land-uses* make it difficult to further develop bioeconomy as a concept used in the forestry education. Moreover, answers showing signs of normative competence are *conservatism*, *the production/environment divide*, *politics*, *lack of innovation* and *lack of dedication*, since they question the current status of these areas.

Putting the results from Table 15 in relation to Figures 16 and 17 in *Chapter 5*, a pattern can be deduced. There is a difference in the responses between bachelor and masters' level, where 79 % of the respondents at masters' level answered question S24 with *not satisfied – quite satisfied* (rating 1-3), compared with 59 % of the respondents at bachelor level. Furthermore, only 14 % of the masters' respondents were *slightly satisfied* or *satisfied* with the extent to which bioeconomy has been addressed. Moreover, 81 % of the total respondents answered that it was *necessary* or *very necessary* to include bioeconomy more in the curriculum. In conclusion, the respondents are not satisfied with what (little) they know yet, and they currently believe that the biggest obstacles are insufficient education, ignorance and conservatism. How this stands in comparison with SLU's goals and obligations, is further investigated in *Chapter 6.4* below.

6.4 Relationship between goals and reality

This subchapter seeks to investigate the relation between the relevant SDG's and the two forestry programme curriculums, as well as the way these goals reflected in the SD competencies and student responses. In Table 16 below, these SDGs, curriculums, competencies and student responses are summarised.

Table 16. Comparison between goals, curriculums and the survey responses

SDG	Curriculum forestry bachelor programme	Curriculum forestry master programme	Corresponding SD competencies	In terms of bioeconomy, student responses indicate that...
SDG 4.7: “All learners should acquire the knowledge needed to promote sustainable development” (UN, 2019, 2)	Critical thinking, independent problem-solving, holistic thinking for forest resource use, social competence, being able to identify own need for further knowledge (SLU, 2016a)	Critical thinking, and critical analysis of sustainable development in the forestry sector, independent problem-solving, holistic thinking for forest resource use, social competence, being able to identify own need for further knowledge, global/international mindset (SLU, 2016b)	Critical thinking Systems thinking <i>Interpersonal*</i> Normative Anticipatory Knowledge (Wiek <i>et al.</i> 2011)	... the respondents are aware of the SD competencies and their importance (although occasionally using other names for them). However, there is a need to further investigate the interpersonal competence, as well as to explore to what extent the students can practise said SD competencies
SDG 15.2: “Implementation of sustainable forests management should be promoted” (UN, 2019, 3)	Information-knowledge and understanding of the forestry practice, its prerequisites, functions and how it interacts with the environment and society (SLU, 2016a)	Knowledge and understanding about the many branches of forest science and the prerequisites for the forest sector (SLU, 2016b)	Knowledge Systems thinking (Wiek <i>et al.</i> 2011)	...the respondents experience that certain aspects, such as insufficient education, ignorance and conservatism could stand in the way of further implementing forest-based bioeconomy
*not investigated in this thesis				

Table 16 above shows the connection between the global SDGs by the UN, the forestry programme curriculums at SLU, the SD competencies by Wiek *et al.* (2011) and the student responses from this study. It should be noted that *bioeconomy* itself is not mentioned in the SDGs, and Table 16 therefore reflects a limited part of the complete attempt of SD implementation (SLU, 2019, 4) at SLU. However, if bioeconomy is envisioned as a tool in the strive for sustainable development, as e.g. Hodge *et al.* (2017) concluded, the implementation at the forestry programmes is still important to investigate.

As shown in Table 16, SDG 4.7 is reflected in the forestry programme curriculums by the mentioning of student qualities resembling *all* SD competencies chosen for the analysis (Figure 19). Moreover, the parts of the curriculums reflecting SDG 15.2 shows formulations similar to the meanings of *Knowledge* and *Systems thinking* competence. Furthermore, as mentioned in earlier subchapters, some qualities cannot be categorised within a SD competence chosen from Wiek *et al.* (2011) for this study. In this case, *the social competence* requested in the curriculums

of both programmes falls under *interpersonal competence* from Wiek *et al.* (*ibid.*). For further discussion on this, see *Chapter 7.4* below.

In conclusion, the responses indicate that the respondents are aware of the competencies aimed for in the curriculums, and thus the SDG's are on the way to becoming realised in SLU's forestry education. Nonetheless, further inquiry is needed, to see whether the forestry students are able to practise said SD qualities in reality.

7 Discussion

In this chapter, the results from the study and analysis of the respondents' perceptions are discussed and put into a bigger perspective.

7.1 Bioeconomy according to Swedish forestry students

“Bioeconomy is an economy based on renewable natural resources” – Anonymous respondent.

The quote above is a good summarisation of the perceptions of bioeconomy among the respondents for this thesis, where many respondents stated that bioeconomy was an economy based on resources being of a renewable, reusable, natural and/or biological nature. Furthermore, the quote also goes well together with the findings from Hodge *et al.*'s (2017) study. There, bioeconomy was the “*part of (an) economy built on the sustainable production of renewable materials from nature*” (*ibid.*, p. 584) according to the three Swedish stakeholder groups investigated. With the results from this study, it therefore seems like four major Swedish forest stakeholders perceive bioeconomy in a similar way. However, the respondents of this study, as well as the study made by Hodge *et al.* (2017), only make up a small share of the total population of forest stakeholders in Sweden, and due to this, no generalisations of stakeholder perceptions can be made. Additionally, in this study, the answers varied greatly, hinting that bioeconomy is still an unclear concept, currently up for interpretation by the user. Accordingly, Table 1 in *Chapter 2* shows that the definitions of bioeconomy vary depending on who uses the concept, and in what context.

“To be a jack-of-all-trades” – Anonymous respondent.

Furthermore, when looking at the competencies of importance in a forest-based bioeconomy (survey question S72), the quote above encompasses the majority of the answers from the survey. The most prominent competencies mentioned by the respondents were *knowledge*, *dedication* and *holistic thinking*. This could indicate that these respondents value driven and knowledgeable fellow stakeholders. Moreover, when analysing the results from S72, the three chosen SD competencies from Wiek *et al.* (2011) were not able to cover the width of the answers. The answers regarding a person having *good communication skills*, being *open-minded*, being a *problem solver* and possessing *flexibility* could all fall under the category of *Interpersonal competence* (*ibid.*), which was excluded from the framework in the initial process. Likewise, answers concerning *logistical thinking* and *efficiency* could fall under the category *Strategic competence* (*ibid.*). The reason why these two competencies were excluded from the framework was that they have a lot to do with how people *act* (e.g. when faced with a group, or a problem), and thus not being very suitable for this survey format. However, the results indicate that the respondents' reflections about bioeconomy were broader than expected. Similarly, Table 6 in *Chapter 3*, shows the *expected* connection between the SD competencies and the research and survey questions, whereas in the *analysis*, all three key competencies as well as the two basic competencies were indicated in *all* open-ended survey questions. For this reason, it could be of use to further investigate the SD competencies among forestry students in Sweden, for instance by carrying out a study based on all five SD competencies by Wiek *et al.* (2011).

Another word frequently appearing as a desired quality was *re-thinking* (Figure 13), which in the analysis was translated into *innovation* (Table 13). For further discussion on this topic, see *Chapter 7.3*.

Looking at bioeconomy as a part of CE it is clear that the respondents in this study value the renewable aspect of the forest resource (Figure 20). However, the idea of maximising the usage of every resource in every step of a products lifecycle, as e.g. described by Esposito *et al.* (2018) and Mishra *et al.* (2018), occurred less frequently. The closest descriptions of bioeconomy as something maximising the usage of a product could be found in answers reflecting bioeconomy as something based on reusable/biofuel/bioenergy/bi products and long-sightedness, as well as the one answer which mentioned that creating a sustainable cycle is the goal of bioeconomy (Figure 20).

7.2 Students' perception of the forests' role

“The forest is Sweden's most important renewable resource” – Anonymous respondent.

When asked to attribute the role of the forest in the Swedish bioeconomy (survey question S37), a clear majority of the respondents (90 %) said it was *rather important* or *important* (as opposed to *not important*, *rather not important* or *undecided*, cf. Figure 14). The reasons given for this were usually in line with the quote above; the forest is an accessible, natural resource that is renewable and reusable. Furthermore, when looking into the differences between the years of studying at the programmes, there was a slightly higher percentage of the students at masters' level attributed the forest with an *important role* (68 %) compared with the students at bachelor level (62 %). Adding the answers stating that the forest is *rather important*, this difference is diminished; 89 % of the students at masters' level and 90 % of the students at bachelor level see the forest as *rather important* or *important*. Furthermore, many of the answers to question S38 reflected the idea that the material from the forest will help to replace many unsustainable products used today. This is something indicated in the current Swedish bioeconomy debate as well, where for instance the SSNC claims that forest-based bioeconomy is usually seen as a tool to replace for instance fossil fuels, plastics and building materials (SSNC, 2019, 1). This expectation is according to SSNC problematic, since it lacks the analysis of the consequences for the environmental goals (*ibid.*). When looking at the student responses for question S38, this apprehension is partly realised; only two respondents questioned whether the forest will suffice to replace all fossil resources (Table 14), whereas a large majority of the remaining answers had an optimistic view on the forest's potential. However, when adding the responses of survey questions S13 and S72 (Figure 20 and Table 13), a more holistic view is indicated. There, a larger share of the respondents takes environmental consequences into account, when describing bioeconomy. Nonetheless, since the forest stands for the majority of Sweden's bioeconomy export (Skånberg *et al.*, 2016), the following quote reflects some of the responses for the forest's role:

“Swedish bioeconomy = Swedish forest sector” - Anonymous respondent.

That the Swedish bioeconomy would be the same as the Swedish forestry sector, as stated by a respondent above, is an assertion not far from the opinions of the forest owners investigated in Hodge *et al.*'s study (2017), where bioeconomy was seen as the current forestry practise. According to them, bioeconomy is *“a tool for society to accept forestry as it is”* (*ibid.*, p. 585). That this is being stated by the respondents as well is both positive and negative, when looking at forestry students as future forest stakeholders. Positive, since they, if this is true, will have a big impact on the growth of bioeconomy in Sweden. Negative, since once again if this opinion exists among their future *business partners* (as described by Roberts, 2003), innovation risks being choked by dominating traditions and perceptions. Once again, simplifying the question of forest-based bioeconomy through only making it about the forest providing natural resources to replace unsustainable resources, risks leaving out the environmental goals and analysis (SSNC, 2019, 1). However, in this study, the respondents clearly showcase *Systems thinking*

competence (Wiek *et al.*, 2011) when it comes to bioeconomy, where matters on societal and environmental sustainability are raised repeatedly in the answers, alongside the more financially focused answers. This decreases the risk of a lacking holistic perspective.

7.3 Students' perception of higher educations' role

According to one of the respondents, the concept of bioeconomy is rarely “(...) *discussed but only mentioned and above all that it isn't problematised or developed so that our understanding of the concept in a bigger perspective is lacking*” at their current forestry programme. This opinion did not stand alone in the answers to question S71, which asked the respondents what obstacles they see for the forest-based bioeconomy in today's education. In general, the respondents at masters' level were less satisfied with the extent to which bioeconomy has been addressed within their programme, compared to the respondents at bachelor level (S24). However, 81 % of the total respondents thought it was *important* or *very important* to address bioeconomy *more* in the University's curricula (S25), that is 86 % of the respondents at masters' and 76 % of the respondents at bachelor level. The difference between bachelor and masters' level is not major, however, the respondents at masters' level were to a higher extent want more education on the topic is quite worrying, since they have spent more than three or four years at their programme and still feel unfamiliar with the concept. Additionally, these perspectives and calls for further implementation are highly relevant, since sustainability is expected to increase in importance as a core mission for universities (Beynaghi *et al.*, 2016). Furthermore, Lozano *et al.* (2013) state that there is still more to be done before sustainability becomes a guiding principle in higher education, and looking at the results for this thesis, this can be said about bioeconomy at SLU as well.

“The forest industry today influences how the education is conducted” – Anonymous respondent.

Three respondents answered that they perceive the industry influence on the forestry programmes as a problem, standing in the way of further implementation of bioeconomy education. Looking at this from a CP point of view, this is of course problematic. Seeing CP as a form of pedagogy which promotes egalitarian power relations (Bizzel, 1991), having one stakeholder group (the industry) executing strong influence on the future stakeholders (the students) could create future inequalities between financial sustainability and environmental or social sustainability, which contradicts the initial purpose of CP (*ibid.*), as well as the TBL (Wayne & MacDonald, 2004). Of course, the forestry programmes are vocational (SLU, 2019, 1; SLU, 2019, 2), and what the industry wants is therefore important to account for, when composing the programmes. However, without gaining an understanding of the other relevant stakeholders (e.g. ENGO's, consumers or society), are the students truly prepared to be future decision makers in such a, for the sustainability debate, fundamental sector? Then again, these were only three answers out of 94 in total, meaning that most respondents did not immediately think of the industry influence as an obstacle at all. In conclusion, how strong the industry influence is, and whether that is positive or negative, should be investigated in further studies.

Furthermore, 14 respondents (Table 13) claimed that *innovativeness* was an important quality to possess within a bioeconomy, an attribute which has been requested in other sustainability-oriented studies as well. For instance, Sandri (2013) states that sustainable development is dependent on innovation, and that ignoring creativity in higher education can stand in the way of social and technological change. With this in mind, that many of the respondents expressed that *conservatism* was an obstacle for further bioeconomy implementation at the programmes (Table 15) is problematic, since it, as the respondents put it, *stands in the way of progress*.

The purpose of higher education, HE, in Sweden, is to “*contribute to learning and the improvement of the development, societal commitment and critical thinking of individuals. Education (...) is needed for a well-educated workforce and creates the preconditions for science and increased knowledge*” (Governmental Offices of Sweden, 2019, 2). When looking at the results from this thesis, this purpose seems to be partly fulfilled; the respondents show signs of critical thinking and a desire for further knowledge, but they claim that they are not educated enough on the subject of bioeconomy. Since many students in Sweden enrol at higher educational programmes to increase their employability (SCB, 2019, 1), the fact that the forestry students experience that their knowledge is insufficient poses a problem for their future stakeholder roles (Roberts, 2003). Even though the focus in stakeholder engagement has shifted from being organisation-centric, with one stakeholder group at the centre, to a network-focused view (Svedsen & Laberge, 2005), the quality of the interactions between said stakeholders very much depends on the competencies the involved stakeholders possess. If students as future forest stakeholders lack the competencies (e.g. Wiek *et al.*, 2011) to solve sustainability issues, the future of bioeconomy in Sweden looks discouraging. However, in this thesis, many SD competencies were indicated in the student responses, and that the respondents are aware that they do not know all there is to know about bioeconomy, can be seen as something positive; in the best of worlds, the survey sparked some respondents to look more into the topic.

7.4 Relationship between goals and reality

This subchapter discusses the final research question: “*How is the relation between the SDGs and the forestry program curriculums, and how are these goals reflected in the student responses?*”. In Chapter 6.4, Table 16 shows an overview of the results for this question. The two SDG’s were 4.7; “*all learners should acquire the knowledge needed to promote sustainable development,*” and 15.2; “*implementation of sustainable forests management should be promoted*”.

Looking at SDG 4.7, the conclusion drawn is that the curriculums *do* reflect the competencies demanded by the SDG. Furthermore, the respondents show awareness of the competencies requested by the curriculum. This conforms Lozano *et al.*’s (2015) findings, where there was a strong correlation between an institution’s sustainability implementation and signing a declaration or initiative. Nonetheless, not all SD competencies by Wiek *et al.* (2011) were investigated in this study; interpersonal competence and strategic competence were deemed too difficult to find in the type of answers the survey generated. Accordingly, the interpersonal competence *is* present in the curriculums, framed as social competence (the ability to collaborate with as well as inspire people around you, *ibid.*), although only slightly present in the survey responses. Thus, there is a need to further investigate this interpersonal competence, as well as to explore to what extent the students can practise *all* SD competencies described in the curriculums.

Moreover, regarding SDG 15.2, the forestry programme curriculums once again reflect the intent of the SDG. Nonetheless, the respondents experience that certain aspects, such as insufficient education, ignorance and conservatism could stand in the way of further implementing forest-based bioeconomy. This has consequences for the implementation of SDG 15.2 at the forestry programmes, since bioeconomy as a part of sustainable forest management, is hindered. A way to avoid this problem in the forestry programmes could be to, as Lozano *et al.* (2013) describe it, make sure that teachers become more proactive and empowered, and get the support needed to practise transdisciplinary teaching. After all, that teacher resources are currently insufficient was a frequently mentioned obstacle for further bioeconomy education in survey question S71 (cf. Table 15).

7.5 Method reflection

As a first delimitation of this thesis, the focus in the framework relied heavily on the competencies described by Wiek *et al.* (2011). Basing the framework on another study could potentially have generated a different result. However, Wiek *et al.* (2011) summarise many previous studies, and have been frequently cited by other researchers in the field of HESD. Furthermore, the quality of the results varies, depending on which aspect that is investigated. The quality of raw data is mostly high, since the respondents many times asked the thesis author when a question was unclear. However, some respondents answered in such an abstract way, that a deeper interpretation by the thesis author was too difficult to carry through. Additionally, the results from the analysis are highly subjective, since it was based on interpreting the answers and categorising these into themes and expressions. However, the aim of the thesis was to get an *overview* of the different perceptions, and thus the quality of the analysis is high in this regard.

Continuing the method reflection, inferential statistics could have been used if the collection process had been carried out by using random sampling. This would have helped in drawing more distinctive conclusions from the collected data. Nonetheless, in this case, descriptive statistics were decided to be sufficient for interpreting and describing the perceptions of the respondents.

Finally, if there was a possibility to carry out a new survey on this same subject, that is the perception of bioeconomy as a concept, a bigger share of open-ended questions is proposed, since these were fruitful when it came to capture the respondents' perception. Furthermore, the survey length and accessibility should be adjusted to make it easier, and more desirable, for the potential respondents to participate. In this case, the survey consisted of 42 questions, and was only accessible *in situ* two days per campus, setting a limitation on how many students who had the possibility to partake.

7.6 The bigger perspective

In the future, the way forest-based bioeconomy is conducted will depend on the knowledge, perceptions and values of the forestry stakeholders (Pätäri *et al.*, 2017). Therefore, the indication that the forestry students at SLU regard the forest as an important or even a key part of the Swedish bioeconomy, while not being satisfied with their current education on the subject, could become an obstacle for further bioeconomy implementation in Sweden. For instance, Matthies *et al.* (2018), found that the more a respondent, i.e. student, perceived themselves to know about a management objective, the higher was their level of acceptance for said objective. Thus, if the respondents for this thesis do not find themselves knowledgeable in certain areas of forest management for bioeconomy, when they later take on their forest stakeholder roles, their ignorance could potentially stand in the way of sustainable innovation. However, Stern *et al.* (2018) found that students had a constructive approach in discussing bioeconomy and tended to have less fear for change, in comparison to other stakeholder groups. If this applies to the respondents in this thesis as well, which is likely since they showcase several competencies needed for such an approach, the risk of their experienced lack of knowledge, keeping them from implementing change, might be lessened.

On an international level, the EC has big plans when it comes to using the growth of bioeconomy as a provider of new opportunities for the forestry sector (EC, 2019, 1). Having forestry students in Sweden that showcase important SD competencies, is an asset for the EU, when carrying out these ambitions. However, there is, according to the results of this study, still work to be done. If the students are going to be a part of the global change, which many other stakeholders hope

they will (Percy-Smith & Burns, 2013), the problem-solving, interpersonal and strategic (Wiek *et al.*, 2011) competencies of the students are vital to ensure. Furthermore, the respondents' experience of lacking knowledge in the bioeconomy field is an urgent matter to address for the people responsible for the forestry programmes at SLU.

Looking at the participants of this survey study, a broader collection of students would have been interesting to investigate, to be able to compare with certain previous studies. For instance, looking at different fields of study or nationality, like Pätäri *et al.* (2017) did, could have provided new perceptions from students with international knowledge, as well as from students studying at programmes which lack a direct connection to the forest industry (in contrast with the respondents in this thesis). As a consequence, the perception of the forest as a great natural resource might have been more questioned by the students who are not educated to work with management of said resource. At least, this was the case with the social science students for Pätäri *et al.* (*ibid.*). The reason these missing perceptions are highlighted in this subchapter is that although a forestry student will play several important roles, as authorisers and business partners among the forestry stakeholders, in the future (Roberts, 2003), a social science student will also partake in some stakeholder roles; as part of a consumer group and/or an external influence group (*ibid.*). Thus, this thesis is missing a group of future stakeholders who are not directly connected to the industry but will have influence on it, nonetheless. Additionally, an international composition of student perspectives, as made by Pätäri *et al.* (2017), would be of value, to see to what extent the bioeconomy competence these Swedish respondents showcase in a bigger perspective. Luckily, this is currently being undertaken by the research team PerForm for several European countries (PerForm, 2019, 1), and will hopefully be a significant contributor to the research field of European bioeconomy.

8 Conclusions

This chapter provides the conclusions drawn from this study. It intends to answer the research questions, as well as given suggestions for further research. Finally, the question asked in the title; “Are the Swedish forestry students being educated for - a sustainable future?” is answered.

8.1 Answers to the research questions

This subchapter describes the conclusions for each research question. In Figure 21, the conclusions are summarised. The figure is further described step by step below.

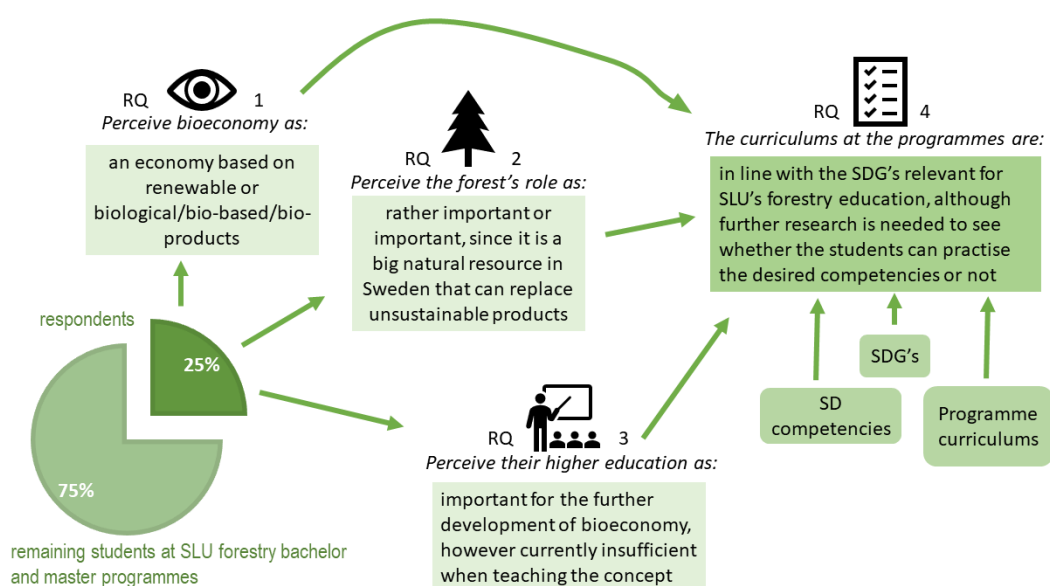


Figure 21. The conclusions for the research questions 1 to 4. From the total population of 416 students at the forestry bachelor and master programmes at SLU, 25 % participated in the survey for this thesis.

Figure 21 above gives an overview of the conclusions made per respective research question and how these are related to each other. For further elaboration on the conclusions, see below.

1. What is bioeconomy, according to Swedish forestry students?

According to the results in this thesis, bioeconomy is among the respondents mostly seen as an economy based on renewable or biological/bio-based/bio-products. Moreover, bioeconomy is by many respondents a concept associated with possessing knowledge, innovative thinking and dedication for change. However, the group of respondents investigated in this thesis does not represent the whole population of forestry students in Sweden, and no further generalisations can thus be made.

2. How do the students perceive the forests' role for the Swedish bioeconomy?

According to a large majority of the respondents, the forests' role in the Swedish bioeconomy was rather important or important. The potential difference between study levels was barely existent, since 89 % of respondents at masters' level and 90 % of the respondents at bachelor level perceive the forest role this way. The motivations behind attributing the national forest

such a role often had to do with the forest's potential to replace unsustainable resources in the market, since the forest is a big natural resource in Sweden.

3. How do the students perceive higher educations' role for the Swedish bioeconomy?

The respondents claimed that education on bioeconomy was important, although they thought it could be more important, and more included in the curriculums at their present programmes. There was a difference between bachelor and masters' level, where the respondents at masters' level were less satisfied with the extent to which bioeconomy currently has been addressed within their programme, compared to the respondents at bachelor level. Additionally, the most frequent mentioned obstacles for further bioeconomy implementation in today's education were; *insufficient education, ignorance and conservatism*.

4. How is the relation between the SDGs and the forestry programme curriculums, and how are these goals reflected in the student responses?

Presiding from the SD competencies by Wiek *et al.* (2011), the SDG's, Sustainable Development Goals, seems to be included in the curriculums. However, the student responses show that further implementation of these goals is needed, since the respondents experience e.g. traditions standing in the way of innovations, which risks causing hinderance for sustainable development.

8.2 Future research recommendations

This thesis should be seen as a pilot study, and as such, further studies filling in the knowledge gaps discovered should be conducted. Below, three suggestions for future research are presented. In short, further research is suggested to;

- Look at the student perceptions at the other forestry programmes offered in Sweden, that is the two forestry bachelor programmes at LNU, Linnaeus University.
- Study the perceptions of international exchange forestry students in Sweden, for instance the students enrolled at the forestry master programme Euroforester at SLU, the Swedish University of Agricultural Sciences.
- Further investigate how the forestry students can apply their SD, sustainable development, competencies when solving sustainability issues.

8.3 Are the Swedish forestry students being educated for a sustainable future?

The final question, regarding whether the Swedish forestry students are being educated for a sustainable future, or not, can be partly answered by the results in this study. In the responses, some of the **SD**, sustainable development, competencies were indicated. Furthermore, the **SDG's**, Sustainable Development Goals, are partly realised in the curriculums and consequentially among the students participating in the survey. However, before drawing any conclusions on the matter, further investigation is needed to see whether the students are able to practise the competencies when faced with sustainability problems, as well as looking deeper into the implementation of interpersonal and strategic competence. Thus, this study concludes that the forestry students are *on their way* to becoming educated for a sustainable future, although how far they have come still remains unclear.

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Personal messages

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Appendices

Appendix 1. The survey (*in Swedish*)

Din syn på skogsbaserad bioekonomi spelar roll



(<https://perform-bioeconomy.info>)

Välkommen till vår undersökning av bioekonomiska perspektiv.

Som skoglig student har du en nyckelroll i den framtida skogsbaserade bioekonomin. Det är därför dina åsikter är så viktiga. Vi är intresserade av att veta mer om hur du ser på bioekonomin idag och i ett framtidsperspektiv.

Studenter på kandidat-, master- och doktorandnivå inom skogsinriktade utbildningar är med i projektet. Utöver studenter i Sverige medverkar också studenter i Italien, Tyskland, Frankrike, Österrike, Finland, Slovakien och Ryssland.

Undersökningen består av en webbenkät indelad i sex delar som fokuserar på din kunskap om och förståelse av några nyckelfrågor samt din syn på framtida karriärmöjligheter. Enkäten tar ca 20 minuter att fylla i och dina svar kommer att analyseras och jämföras med dina Europeiska kollegors resultat.

Vill du veta mer om projektet?

PerForm är ett europeiskt samarbete finansierat av European Forest Institute (EFI). Vi är ett internationellt team av samhällsvetenskapliga forskare från åtta topprankade universitet i Europa som undersöker olika förståelser av en skogsbaserad bioekonomis roll i samhället.

PerForm syftar till att öka kunskapen om regionala skillnader i nationella bioekonomipolicies och till att undersöka mångfalden av perspektiv på, samt acceptansen för, en skogsbaserad bioekonomi bland olika aktörer i Europa och Ryssland.

För mer information: <https://perform-bioeconomy.info> (<https://perform-bioeconomy.info>)

PerForm partners:



Extern samarbetspartner:

**Integritetspolicy**

Data insamlad genom denna undersökning kommer behandlas konfidentiellt och anonymt i forskningssyfte och i enlighet med dataskyddsförordningen GDPR (General Data Protection Regulation), Regulation (EU) 2016/679.

Genom att fylla i webenkäten ger du forskarna i PerForm tillåtelse att processa dina svar inom ramen för nätverkets forskning.

Undersökningen innehåller 40 frågor

There are 42 questions in this survey

S1 - How familiar are you with bioeconomy?

[]S11 - Har du vid något tillfälle hört talas om bioekonomi eller biobaserad ekonomi?

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Ja
☐ Nej

[]S12 - Om ja, i vilket sammanhang?

Check all that apply

Please choose **all** that apply:

- ☐ Praktiska utbildningar
☐ Konferenser
☐ Universitetskurser
☐ Vetenskapliga publikationer
☐ Policydokument
☐ Nyheter
☐ Sociala medier
☐ Kollegor
☐ Other:

[]S13 - Utifrån din personliga förståelse, hur skulle du definiera bioekonomi med egna ord?

Please write your answer here:

Max 50 ord

[]S14 - Enligt din kännedom, har den Europeiska Union en specifik bioekonomistrategi?

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Ja
- ☐ Nej
- ☐ Vet ej

[]S15 - Enligt din kännedom, finns det någon nationell eller industrispecifik bioekonomistrategi i ditt hemland?

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Ja
- ☐ Nej
- ☐ Vet ej

S2 - Bioekonomi vid universitetet

Den Europeiska Kommissionen definierar bioekonomi enligt nedan:

"Bioekonomi omfattar produktionen av förnyelsebara biologiska resurser och omvandlingen av dessa förnyelsebara biologiska resurser samt sidoströmmar till produkter med högre förädlingsvärde, t.ex. mat, foder, biobaserade produkter och bioenergi. Dess sektorer och industrier har stark innovationspotential till följd av ett brett nyttjande av olika vetenskaper, möjliggörande och industriella teknologier, i kombination med lokal och erfarenhetsbaserad kunskap".

[]S21 - Vid ditt universitet är bioekonomi:

Check all that apply

Please choose **all** that apply:

- ☐ Presenterad som en vetenskaplig utgångspunkt och ryggrad för hela studieprogram
- ☐ Adresserad i en eller fler kurser
- ☐ Adresserad i ett eller fler utbildningsmoment (t.ex. workshops, seminarier, konferenser)
- ☐ Omnämnt i en eller fler kurser
- ☐ Inte adresserad eller omnämnd i någon kurs
- ☐ Vet ej

[]S22 - Inom ditt studieprogram, vilka kurser har erbjudit givande lärandeförhållanden för ökad förståelse av en skogsbaserad bioekonomi? Ange kursnamn här:

Please write your answer here:

[]

S23 - I vilken utsträckning tycker du att bioekonomi adresseras inom studieprogrammets läroplan? (var god beakta alla kurser du har kunnat gå inom ditt program).

[1= inte alls, 2= sällan, 3= ibland, 4=ofta, 5=väldigt ofta]

Please choose **only one** of the following:

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4

☐ 5

[]

S24 - Hur nöjd är du med hur bioekonomi adresseras inom ramen för dina studier?

[1= inte nöjd, 2= lite nöjd, 3=ganska nöjd, 4 =nöjd, 5 =väldigt nöjd]

Please choose **only one** of the following:

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

[]

S25 - Tycker du att det är nödvändigt att adressera bioekonomi mer inom universitetets läroplaner?

[1=inte alls; 5=väldigt nödvändigt]

Please choose **only one** of the following:

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

[]S26 - Har du, eller planerar du att utveckla en uppsats med fokus på bioekonomi?

Choose one of the following answers

Please choose **only one** of the following:

☐ Ja

☐ Nej

[]S27 - Om ja, ange den preliminära titeln och viktigaste frågorna.

Please write your answer here:



S3 - Bioekonomiska perspektiv

[]

S31 - Enligt din åsikt, i vilken utsträckning bidrar följande sektorer till bioekonomin **i Europa?**

[1= inte alls, 2= sällan, 3= ibland, 4= ofta, 5= väldigt ofta]

Please choose the appropriate response for each item:

	1	2	3	4	5
Jordbruk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bioenergi och biobränslen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Byggnation och konstruktion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kemi	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utbildning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Foder	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fiske och akvakultur	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mat och dryck	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skogsbruk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Djurhållning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Läkemedel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Massa och papper	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Textil	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Turism och rekreation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[]S32 - Tycker du att det finns andra sektorer som bör läggas till listan ovan? Ange dessa här:

Please write your answer here:

[]

S33 - Enligt din åsikt, i vilken utsträckning bidrar dessa sektorer till bioekonomin **i det land du studerar?**

[1= inte alls, 2= sällan, 3= ibland, 4= ofta, 5= väldigt ofta]

Please choose the appropriate response for each item:

	1	2	3	4	5
Jordbruk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bioenergi och biobränslen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Byggnation och konstruktion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	1	2	3	4	5
Kemi	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utbildning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Foder	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fiske och akvakultur	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mat och dryck	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skogsbruk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Djurhållning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Läkemedel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Massa och papper	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Textil	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Turism och rekreation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[]S34 - Tycker du att det finns andra sektorer som bör läggas till listan ovan? Ange dessa här:

Please write your answer here:

[]S35 - Enligt dig, hur relevant är **skogens roll** inom bioekonomin **i Europa**?

[1= inte viktig alls, 2 =inte särskilt viktig, 3= varken eller, 4= ganska viktig, 5= mycket viktig]

Please choose **only one** of the following:

- ☐ 1
☐ 2
☐ 3
☐ 4
☐ 5

[]S36 - Motivera ditt val ovan med vad du tycker är de viktigaste argumenten

Please write your answer here:

[]

S37 - Enligt dig, hur relevant är skogens nuvarande roll inom bioekonomin **i det land där du studerar?**

[1= inte viktig alls, 2= inte särskilt viktig, 3= varken eller, 4= ganska viktig, 5= mycket viktig]

Please choose **only one** of the following:

- ☐ 1
☐ 2
☐ 3
☐ 4
☐ 5

[]S38 - Motivera ditt val ovan med vad du tycker är de viktigaste argumenten

Please write your answer here:

[]

S39 - Enligt många forskningsrapporter kan bioekonomin bidra till en utveckling av skogsbruket. Enligt dig, i vilken utsträckning drivs utvecklingen av följande aspekter framåt av bioekonomin idag?

[1= inte alls, 2= sällan; 3= ibland, 4= ofta, 5= väldigt ofta]

Please choose the appropriate response for each item:

	1	2	3	4	5
Helt nya produkter och teknologier (t.ex. biokemikalier, nano-cellulosa...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Förbättring av existerande produkter (t.ex. träprodukter för byggsektorn)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Effektivt nyttjande av skogsbaserade produkter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nya användning av befintliga produkter (t.ex. cellulosa/kork inom byggsektorn)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	1	2	3	4	5
Ersättning av fossila bränslen med skogsbiomassa för energi produktion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Värdering av den mångfald av tjänster/produkter som kommer från skogen (t.ex. ekosystemtjänster)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[]S310 - Finns det, som du ser det, ytterligare relevanta aspekter av bioekonomin än de listade ovan? Ange dessa här:

Please write your answer here:

[]S311 - Som naturresurs förväntas skogen ha en central roll för bioekonomiutvecklingen. Det är därför vi kan tala om en skogsbaserad bioekonomi som en specifik gren inom bioekonomin. I vilken grad håller du med om följande påståenden?

[1= håller inte alls med, 2= håller inte med, 3= varken eller, 4= håller med, 5= håller helt med]

Utvecklingen av en skogsbaserad bioekonomi:

Please choose the appropriate response for each item:

	1	2	3	4	5
Ska drivas av teknisk utveckling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ska vara orienterad mot produkter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ska vara orienterad mot tjänster (t.ex. ekosystemtjänster)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ska baseras på lokala resurser	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ska baseras på naturresurser, oberoende av om de är lokalproducerade eller importerade	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ska försöka att kombinera ny och traditionell kunskap	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kommer att skapa arbetstillfällen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kommer att gynna hållbar skogsskötsel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kommer att gynna skogsskötsel på lokal nivå	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kommer att gynna skogsskötsel oavsett på vilken nivå	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kommer att leda till avskogning/skogsdegradering	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kommer att öka människors medvetenhet om miljö- och skogsfrågor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[]S312 - Vilka är de viktigaste nyckelorden för bioekonomin? Markera de **tre** ord du tycker är viktigast

i listan här nedan.

Check all that apply

Please select 3 answers

Please choose **all** that apply:

- ☐ Bioraffinaderier
☐ Minskande koldioxidutsläpp
☐ Ekosystemtjänster
☐ Effektivitet
☐ Energi
☐ Industri
☐ Innovation
☐ Produkter
☐ Landsbygdsutveckling
☐ Socialt kapital
☐ Teknologi
☐ Other:

[]

S313 - Vilka tror du **gynnas** av utvecklingen av en skogsbaserad bioekonomi?

[1= gynnas inte alls, 2= gynnas lite, 3= gynnas något mer, 4= gynnas mycket, 5= gynnas väldigt mycket]

Please choose the appropriate response for each item:

	1	2	3	4	5
Små privata skogsägare	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stora privata skogsägare	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Allmänna skogsägare	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skogsföretag	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pappers- och massafabriker	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sågverk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Träindustrier	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Andra industrier som använder skogsprodukter som insatsvara (t.ex. energiproduktion, textilier...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Handlare av skogsprodukter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Konsulter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Finansiella aktörer (tex investeringsfonder)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Samhället i stort	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[]

S314 - Vilka tror du **förlorar** på utvecklingen av en biobaserad ekonomi?

[1= förlorar inte alls, 2= förlorar lite, 3= förlorar något mer, 4= förlorar mycket, 5= förlorar väldigt mycket]

Please choose the appropriate response for each item:

	1	2	3	4	5
Små privata skogsägare	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stora privata skogsägare	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Allmänna skogsägare	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skogsföretag	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pappers- och massafabriker	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sågverk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Träindustrier	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Andra industrier som använder skogsprodukter som insatsvara (t.ex. energiproduktion, textilier...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Handlare av skogsprodukter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Konsulter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Finansiella aktörer (tex investeringsfonder)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Samhället i stort	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

S4 - Problem och möjligheter

[]S41 - Enligt dig, vilka är de huvudsakliga **drivkrafterna** bakom omställningen till en skogsbaserad bioekonomi? Markera de **tre** drivkrafter i listan här nedan som du tycker är de viktigaste:

Check all that apply
Please select 3 answers

Please choose **all** that apply:

- ☐ Klimatförändringarna
- ☐ Ersätta icke-förnyelsebara (t.ex. fossilbaserade) produkter och material
- ☐ Behov av hållbarhet
- ☐ Befolkningsökning
- ☐ Ekonomisk utveckling
- ☐ Naturresursförbrukning
- ☐ Behovet av hitta nya marknader och produkter
- ☐ Regleringar: nationella/internationella policies
- ☐ Teknologisk utveckling
- ☐ Miljöförstöring
- ☐ Ökad generationell medvetenhet om hållbar utveckling
- ☐ Sociala mediers normskapande roll
- ☐ Hållbarhetsstandarder
- ☐ Other:

[]S42 - Enligt dig, vilka anser du vara de största **hindren** för en omställning till en biobaserad ekonomi? Markera de **tre** hinder i listan här nedan som du tycker är störst:

Check all that apply
Please select 3 answers

Please choose **all** that apply:

- ☐ Samhällelig fränkoppling från naturen - urbanisering
- ☐ Byråkrati (gör skogsbrukande komplext och svårt)
- ☐ Oklara regler och policyriktlinjer
- ☐ Kostnader
- ☐ Normativt motstånd
- ☐ Konkurrerande ekonomiska intressen och sektorer
- ☐ Skog som en begränsad resurs
- ☐ Other:

[]S43 - Vilka är de viktigaste **möjligheterna** med

omställningen till en biobaserad ekonomi? Markera de **tre** alternativ i listan här nedan som du tycker är viktigast:

Check all that apply

Please select 3 answers

Please choose **all** that apply:

- ☐ Att öka medvetenheten om miljöfrågor bland samhällsmedborgare
- ☐ Att främja skogssektorn
- ☐ Att stödja en effektiv användning av skogsresurser
- ☐ Att göra skogssektorn mer accepterad av allmänheten
- ☐ Att uppvisa skogssektorn som en del av en grönare framtid
- ☐ Att skapa fler arbetstillfällen
- ☐ Other:

S5 - Bioekonomi: framtidsperspektiv

[]S51 - Vilken typ av jobb skulle du vilja ha när du är färdig med din utbildning (undervisning, forskning, företag, politik/offentlig förvaltning)? Skriv en jobbeskrivning.

Please write your answer here:

[]S52 - Tror du att utvecklingen av en skogsbaserad bioekonomi kan hjälpa dig hitta ett sådant jobb? Välj ett av följande svar.

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Ja
☐ Nej
☐ Vet ej

[]S53 - Tror du att utvecklingen av en skogsbaserad bioekonomi kan bidra till fler arbetstillfällen generellt? Välj ett av följande svar.

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Ja
☐ Nej
☐ Vet ej

[]S54 - Vilka prioriteringar bör göras för att stödja framväxten av arbetstillfällen inom utvecklingen av en skogsbaserad ekonomi? Ange dina **tre** topprioriteringar

Please write your answer(s) here:

Prioritet 1

Prioritet 2

Prioritet 3

S6 - Generell information om respondenten

[]S61 - Ålder (antal år) Endast siffror kan anges.

Only numbers may be entered in this field.

Please write your answer here:

[]S62 – Kön

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Man
☐ Kvinna
☐ Vill inte ange

[]S63 – Nationalitet

Please write your answer here:

[]S64 - För närvarande inskriven på kurs eller program på följande nivå (välj ett alternativ)

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Kandidatnivå
☐ Masternivå
☐ Doktorandnivå
☐ Other

[]S65 - Om du går ett program, vilken termin studerar du? Välj ett av alternativen nedan:

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Termin 1

☐ Termin 2

☐ Termin 3

☐ Termin 4

☐ Termin 5

☐ Termin 6

☐ Other

[]S66 - Institut. Ange: universitet/fakultet/institution.

Please write your answer here:

[]S67 - Är du Erasmus-student eller del av något annat utbytesprogram (Joint Study, CEEPUS, etc.)?

Choose one of the following answers

Please choose **only one** of the following:

☐ Ja, Erasmus

☐ Ja, Erasmus Mundus

☐ Nej

☐ Other

S7 - Två frågor att klargöra

[]S71 - Vad ser Du som hinder för utveckling av det skogliga bio-ekonomibegreppet i dagens utbildning?

Please write your answer here:

[]S72 - Vilka färdigheter tror Du är viktiga inom området skoglig bioekonomi?

Please write your answer here:

Slut på enkäten

Tack för att du deltog i undersökningen: genom att fylla i enkäten och dela dina insikter hjälper du oss få en bättre förståelse för framtida intressenters synsätt och kunskaper om en skogsbaserad bioekonomi inom EU.

Om du vill veta mer om undersökningen, hålla utkik efter PerForms projektuppdateringar eller hålla koll på aktuella och framtida forskningsmöjligheter, följ oss på <https://perform-bioeconomy.info> (<http://www.perform-bioeconomy.info/>)

Stay tuned!

PerForm team

Submit your survey.

Thank you for completing this survey.

Appendix 2. The survey (*in English*)

Your opinion about the forest-based bioeconomy matters



(<https://perform-bioeconomy.info>)

Welcome to our survey on forest-based bioeconomy perceptions.

As a forestry student, you are a key-future stakeholder for the forest-based bioeconomy. This is why your opinion is so important. We are interested in knowing more about how you perceive bioeconomy today and in a future perspective.

All forestry students –including Bachelor, Master and Doctorate ones– from Italy, Germany, France, Austria, Finland, Sweden, Slovakia and Russia can participate in this survey.

This survey consists of an online questionnaire structured into 6 sections –focusing on your knowledge and perception of some key-topics, to perspectives in terms of future job opportunities– and will take about 20 minutes of your time. Your responses will be later analyzed and compared with those of your colleagues from across Europe.

Want to know more about the project?

PerForm is a European cooperation network supported by the European Forest Institute (EFI). We are an international team of social scientists from eight top-ranked European research institutions, investigating societal perceptions of the forest-based bioeconomy.

PerForm aims to better understand regional disparities of national bioeconomy policies and explore the diversity of perceptions and acceptance of a forest-based bioeconomy by different forest stakeholders

across Europe and Russia.

For more information: <https://perform-bioeconomy.info> (<https://perform-bioeconomy.info>)

PerForm partners:



External cooperation institution:



Privacy notice

Data collected through this survey will be treated confidentially and anonymously for the purposes of PerForm project research, in compliance with the General Data Protection Regulation (GDPR), Regulation (EU) 2016/679.

By filling the questionnaire you give PerForm network staff the permission to process data you provide for the purposes of PerForm project research.

There are 41 questions in this survey

Select your language

☐

Please select your language from the menu or select additional languages through links given below:

- Finnish (<https://survey.boku.ac.at/index.php/survey/index/sid/516188/newtest/Y/lang/en>)
- Slovak (<https://survey.boku.ac.at/index.php/749872?newtest=Y&lang=en>)
- Swedish (<https://survey.boku.ac.at/index.php/survey/index/sid/649136/newtest/Y/lang/en>)

S1 – How familiar are you with bioeconomy?

[]S11 - Have you ever heard about bioeconomy or bio-based economy?

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Yes
☐ No

[]S12 - If yes, where?

Check all that apply

Please choose **all** that apply:

- ☐ Training courses
☐ Conferences
☐ University courses
☐ Scientific Papers
☐ Policy documents
☐ News
☐ Social media
☐ Colleagues
☐ Other:

[]S13 - How would you define bioeconomy, according to your personal understanding?

Please write your answer here:

Max 50 words

[]S14 - To your best knowledge, does the European Union have a specific strategy for bioeconomy?

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Yes
- ☐ No
- ☐ I do not know

[]S15 - To your best knowledge, are you aware of a national or an industry specific strategy for bioeconomy in your home country?

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Yes
- ☐ No
- ☐ I do not know

S2 - Bioeconomy at university

The European Commission defines bioeconomy as follows:

"Bioeconomy encompasses the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy. Its sectors and industries have strong innovation potential due to their use of a wide range of sciences, enabling and industrial technologies, along with local and tacit knowledge".

[S21 - Within your university course, bioeconomy is:

Check all that apply

Please choose **all** that apply:

- ☐ Presented as an epistemological starting point for the entire program being a back bone in the program itself
- ☐ Addressed in one or more dedicated modules/courses
- ☐ Addressed in one or more dedicated parallel initiatives (e.g. workshops, seminars, conferences...)
- ☐ Mentioned in one or more non-dedicated modules/teachings
- ☐ Not addressed or mentioned in any modules/teaching
- ☐ I do not know

[S22 - In your current program, what course has offered beneficial learning conditions to promote the understandings of forest-based bioeconomy? Please enter the course name.

Please write your answer here:

[S23 -

Overall to what extent do you think bioeconomy is addressed within your university curriculum? (note: please consider all credited courses you have been able to take in your program)

[1 = not at all, 2 = seldomly; 3=sometimes, 4=often, 5=very often]

Please choose **only one** of the following:

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

[]

S24 - How much are you satisfied with the extent to which bioeconomy is currently addressed within your university course?

[1=not satisfied, 2= little satisfied, 3= rather satisfied, 4= satisfied 5=very satisfied]

Please choose **only one** of the following:

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

[]

S25 - Do you think it is necessary to address bioeconomy more in your University's curricula?

[1=no, 2=yes, a little bit, 3=yes, rather more, 4=yes, more, 5= yes, very much more]

Please choose **only one** of the following:

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

[]S26 - Are you currently developing/planning to develop a thesis dealing with bioeconomy issues?

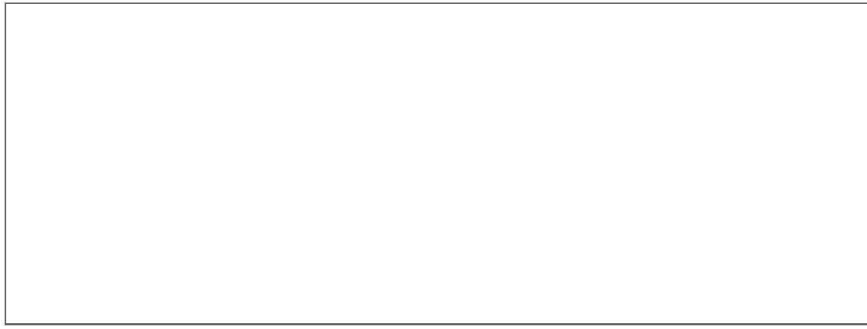
Choose one of the following answers

Please choose **only one** of the following:

- ☐ Yes
- ☐ No

[]S27 - If yes, please enter the (expected) title and/or the main topics

Please write your answer here:



S3 - Bioeconomy perception

[]

S31 - In your opinion, to what extent do these sectors contribute to bioeconomy **in Europe**?

[1= not at all, 2= seldomly; 3= sometimes, 4= often, 5= very often]

Please choose the appropriate response for each item:

	1	2	3	4	5
Agriculture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bioenergy and biofuels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Building and constructions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chemistry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Education	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fishery and aquaculture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food and beverages	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forestry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Livestock	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pharmaceutical	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pulp and paper	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Textile	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tourism and recreation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[]S32 - Do you think there is any other sector that should be included within the above-reported list?
Please enter those sector(s)

Please write your answer here:

[]

S33 - In your opinion, to what extent do these sectors contribute to bioeconomy **in the country where your academic program is offered**?

[1= not at all, 2= seldomly; 3= sometimes, 4= often, 5= very often]

Please choose the appropriate response for each item:

1 2 3 4 5

	1	2	3	4	5
Agriculture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bioenergy and biofuels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Building and constructions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chemistry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Education	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fishery and aquaculture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food and beverages	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forestry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Livestock	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pharmaceutical	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pulp and paper	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Textile	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tourism and recreation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[S34 - Do you think there is any other sector that should be included within the above-reported list? Please enter those sector(s)]

Please write your answer here:

[S35 - In your opinion, how important is the **current role** of forests within bioeconomy **in Europe**?

[1= not important, 2= rather not important, 3= undecided, 4= rather important, 5= important]

Please choose **only one** of the following:

- ☐ 1
☐ 2
☐ 3
☐ 4
☐ 5

[S36 - Please motivate your choice by reporting the main reasons/arguments for attributing such a role

Please write your answer here:

[]
S37 - In your opinion, how relevant is the **current role** of forests within bioeconomy **in the country where your academic program is offered?**

[1= not important, 2= rather not important, 3= undecided, 4= rather important, 5= important]

Please choose **only one** of the following:

- ☐ 1
☐ 2
☐ 3
☐ 4
☐ 5

[]S38 - Please motivate your choice by reporting the main reasons/arguments for attributing such a role.

Please write your answer here:

[]
S39 - According to various studies, bioeconomy could contribute developing forestry. In your opinion, to what extent are the following aspects/issues developed through bioeconomy nowadays?

[1= not at all, 2= seldomly, 3= sometimes, 4= often, 5= very often]

Please choose the appropriate response for each item:

1 2 3 4 5

	1	2	3	4	5
Totally new products and technologies (e.g. biochemicals, nanocellulose...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improvement of existing products (e.g. engineered wood products for the building sector)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Efficient use of forest-based products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
New uses for existing products (e.g. cellulose/cork used in the building sector)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Substitution of fossil fuels with forest biomass for energy purposes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Valuing of multiple services/products offered by forests (e.g. ecosystem services)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[]S310 - Is there any other relevant aspect/issue you would like to include in addition to those listed within S39 above? Please indicate aspect(s)/issue(s)

Please write your answer here:

[]
S311 - As part of the natural capital, forests are largely expected to play a central in bioeconomy development. This is why we can specifically speak about forest-based bioeconomy, i.e. that specific branch of bioeconomy that relies on forest resources.

To what extent do you agree/disagree with the following statements?

The development of a forest-based bioeconomy:

[1= disagree, 2= rather disagree, 3= undecided, 4= rather agree, 5= agree]

Please choose the appropriate response for each item:

	1	2	3	4	5
Shall be driven by technological developments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shall be oriented to products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shall be oriented to services (e.g. ecosystem services)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shall be based on local resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shall be based on nature resources, no matter if they are local or imported	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	1	2	3	4	5
Shall try to combine new and traditional knowledge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Will promote employment opportunities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Will favour sustainable forest management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Will promote forest management at local scale	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Will promote forest management, no matter at which scale	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Will lead to increased deforestation/forest degradation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Will increase people's awareness of environmental and forestry issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[]

S312 - In your opinion, which are the most relevant key-words for bioeconomy? Please select the top 3 key-words for bioeconomy within the list given-below.

Check all that apply

Please select 3 answers

Please choose **all** that apply:

- ☐ Biorefineries
- ☐ Decarbonisation
- ☐ Ecosystem services
- ☐ Efficiency
- ☐ Energy
- ☐ Industry
- ☐ Innovation
- ☐ Products
- ☐ Rural development
- ☐ Social capital
- ☐ Technology
- ☐ Other:

[]

S313 - Whom do you expect to benefit/gain from the development of a forest-based bioeconomy?

[1= no benefit/gain at all, 2= little benefit/gain, 3= moderate benefit/gain 4= high gain/benefit, 5= very high benefit/gain]

Please choose the appropriate response for each item:

	1	2	3	4	5
Small private forest owners	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Big private forest owners	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public forest owners	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forest enterprises	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pulp and paper mills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	1	2	3	4	5
Sawmills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wood industries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other industries using forest products as inputs (e.g. energy, textile...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forest product traders	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consultants	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Financial actors (e.g. investment funds)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Society at large	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[]

S314 - Whom do you expect to lose/suffer from the development of a forest-based bioeconomy?

[1= no loss at all, 2= some loss, 3= moderate loss, 4= high loss 5 = very high loss]

Please choose the appropriate response for each item:

	1	2	3	4	5
Small private forest owners	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Big private forest owners	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public forest owners	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forest enterprises	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pulp and paper mills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sawmills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wood industries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other industries using forest products as inputs (e.g. energy, textile...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forest product traders	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consultants	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Financial actors (e.g. investment funds)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Society at large	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

S4 - Problems and opportunities

[]

S41 - In your opinion, what are the main **drivers** associated with a transition to a forest-based bioeconomy? Please select the **top 3** drivers for bioeconomy within the list given-below:

Check all that apply
Please select 3 answers

Please choose **all** that apply:

- ☐ Climate change
- ☐ Substituting non-renewable (e.g. fossil-fuel based) products/materials
- ☐ Need for sustainability
- ☐ Population increase
- ☐ Economic development
- ☐ Natural resource depletion
- ☐ Need to find new markets and products
- ☐ Regulations: national/international policy
- ☐ Technology developments
- ☐ Environmental degradation
- ☐ Generational increase in awareness of sustainable development
- ☐ Social medias' role in shaping norms
- ☐ Sustainable development standards
- ☐ Other:

[]

S42 - In your opinion, what are the main **problems/barriers** associated with a transition to a forest-based bioeconomy? Please select the **top 3** problems/barriers for bioeconomy within the list given-below:

Check all that apply
Please select 3 answers

Please choose **all** that apply:

- ☐ Societal disconnection from nature – urbanisation
- ☐ Bureaucracy (turning forest utilisation complex and difficult)
- ☐ Unclear regulations or policy guidance
- ☐ Costs
- ☐ Normative resistance

☐ Competing economic interests and sectors

☐ Forests as limited resources

☐ Other:

[]

S43 - In your opinion, what are the main opportunities associated with a transition to a forest-based bioeconomy? Please select the top 3 opportunities for bioeconomy within the list given-below:

Check all that apply

Please select 3 answers

Please choose **all** that apply:

☐ To increase society's awareness on environmental issues

☐ To promote/value the forest sector

☐ To support an efficient use of forest resources

☐ To make the forest sector more accepted by the public opinion

☐ To show the forest sector as part of a greener future

☐ To create more job opportunities

☐ Other:

S5 - Bioeconomy: looking forward

[]S51 - What kind of job would you like to have once you are finished with your university course (teaching, research, business, policy/public administration...)? Please enter a job description

Please write your answer here:

[]S52 - Do you think the development of a forest-based bioeconomy can help you finding such a job?

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Yes
☐ No
☐ I do not know

[]S53 - Do you think the development of a forest-based bioeconomy can help creating more job opportunities in general?

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Yes
☐ No
☐ I do not know

[]S54 - In your opinion, what are the priorities that should be defined/given to support employment opportunities within the development of a forest-based bioeconomy? Please report the **three top-priorities**

Please write your answer(s) here:

Priority 1

Priority 2

Priority 3

S6 - General info on respondent

[]S61 - Age (n. of years)

Only numbers may be entered in this field.

Please write your answer here:

[]S62 - Gender

Please choose **only one** of the following:

☐ Female

☐ Male

[]S63 - Nationality

Please write your answer here:

[]S64 - Currently enrolled in the following university program (please choose one option)

Choose one of the following answers

Please choose **only one** of the following:

☐ Bachelor (BSc)

☐ Master (MSc)

☐ Doctorate (PhD)

☐ Other

[]S65 - Semester of attendance

Choose one of the following answers

Please choose **only one** of the following:

☐ 1st

☐ 2nd

☐ 3rd

☐ 4th

☐ 5th

☐ 6th

☐ Other

[]S66 - Institution. Enter hosting institution name: University and School/Department/Faculty.

Please write your answer here:

[]S67 - Are you an Erasmus student or are you taking part in another exchange program (Joint Study, CEEPUS, etc.)?

Choose one of the following answers

Please choose **only one** of the following:

- ☐ Yes, Erasmus
- ☐ Yes, Erasmus Mundus
- ☐ No
- ☐ Other

End of questionnaire

Thanks for participating to the survey: by filling-in the questionnaire and sharing your views you help us gaining a better understanding of future stakeholders' perception and knowledge on forest-based bioeconomy in the EU.

If you want to know more about the survey follow-ups, check for PerForm project updates and look for current and future research opportunities, follow us on <https://perform-bioeconomy.info> (<http://www.perform-bioeconomy.info/>)

Stay tuned!

PerForm team

Submit your survey.

Thank you for completing this survey.

Appendix 3. Analysis of survey question S71

S71- What obstacles do you see for the forest-based bioeconomy in today's education?

Person	Meaning unit	Condensed meaning unit	Code
166	Conservatism, bureaucracy and fear of failure	-	Conservatism Bureaucracy Fear
160	That it maybe feels a little blurry and that the education isn't developed in line with society	Blurry education that isn't in line with society	Unclear Lack of societal connection
156	Bureaucracy and old fashioned way of thinking	-	Bureaucracy Conservatism
154	That there are other things that are at least as interesting	Not interesting enough	Uninteresting topic
153	The will to be at the forefront in this development. Inspiration about that we can save the world if we do everything right.	-	Lack of dedication Lack of innovation
136	-		
131	-		
122	That many teachers are from the older generation and don't know themselves what the term means. More scientists who are caught up on the topic are needed during the first study years and at least one course on the subject should be mandatory.	Older teachers that don't know. New scientist (aka teachers) with modern knowledge needed.	Teachers (as a resource) Lack of knowledge Better education planning
119	-		
118	Don't know		Don't know

115	-		
113	Financial interests that transcend nature - and environmental conservation needs, that in my opinion should be prioritized in Sweden. This would lead to a non-objective learning process about bioeconomy. Think an all-around analysis of the pros and cons of bioeconomy in the forest, society AND climate is needed. Mostly to give the students the opportunity to explore the theme on their own and form their own opinion.	Financial interest are prioritized above environmental ones, leads to non-objective learning process. all-around analysis needed.	Production focus Economy Better educational planning Industry influences education Lack of whole perspective
112	Courses directly linked to bioeconomy are absent		Better educational planning
111	That the concept rarely is discussed but only mentioned and above all that it isn't problematised or developed so that our understanding of the concept in a bigger perspective is lacking.	Concept rarely discussed Lack of bigger perspective Lack of knowledge as a result	Concept not used Better educational planning Lack of knowledge Lack of bigger perspective
109	Too little exposure and usage of the concept Too much focus on traditional forestry Lack of interdisciplinary perspectives - climate science and business administration are important areas to include	Too lite usage of the concept, focus is on traditional forestry, other perspectives lacking	Concept not used Traditions Lack of other perspectives
108	Don't know. Don't really understand the question. There is probably good opportunity for the universities to discuss bioeconomy but it is a traditional sector that makes it difficult to implement new things.	Don't understand question. Universities can discuss bioeconomy, but traditions are in the way of implementation	Don't know Don't understand Traditions
107	That there is a stop after marketing the concept. There has to be someone/something that follows up the meaning better.	-	Lack of dedication Lack of whole perspective
106	People who don't want to see clear-cuts	-	Anti-forestry people

105	-		
104	Make the forest last for both environmental protection and production	The production/environment divide	The production/environment divide Lack of forest
103	Continued usage of fossile fuels	-	Fossile fuels
102	That we don't start educating people at an (enough) early age. It takes many years after high school for people to learn enough to be able to apply their knowledge		Better educational planning (in mandatory school)
101	A financial driving force from oil and coal companies where a lot of money is. They have no incentives to change their business since there is an unfathomable amount of profit to make for them. It is rather needed to, through directions from policy and laws, increase selective measures to make it more difficult for them to carry out their business.	The oil economy big financial driver. Lack of incentives for change. This needs to be regulated by law.	Economy Lack of incentives for change Need for regulation
100	Old geezers that refuse to acknowledge other services than the strictly financial. Jokes aside. But the traditional way of perceiving the forest needs to be renewed. That is where the big challenge lies. The term bioeconomy must begin to be used and established in the everyday speech for the development to move forward.	Older generation focus on the financial, traditions stand in the way. Bioeconomy needs to be used in everyday speech to become established.	Traditions Concept not used
98	-		
97	I believe old habits are the biggest obstacles currently		Traditions
96	Don't know		Don't know
95	Lack of knowledge		Lack of knowledge

94	Climate change, the want to create innovation.	Lack of innovation Lack of dedication Climate change
93	Don't know	
92	That the usage of the land will increase, and then at whoms expense? Well lokal populations and other industries that already exists and have existed for a thousand years (for instance the reindeer industry)	land usage will increase and the locals will suffer (ie reindeer industry) Land use planning
91	Regulation of the forestry practice	Too much regulation
90	Can't see any obstacles at present	No obstacles
89	There is too small a share of this in educations.	Better educational planning
88	That we don't get enough knowledge about the subject	Lack of knowledge Better educational planning
87	There is a slight divide between the students that are more interested in nature conservation and those who are more interested in forest production. There a poor consensus of the area might arise due to seeing eachother as "antagonists".	The production/environment divide
86	Lack of knowledge	Lack of knowledge
85	It is big and difficult to define.	Unclear concept
84	-	
83	Old ways of thinking. Little encouragement for innovation	Conservatism Lack of incentives for change

82	Dedication and time. I don't think that all teachers are interested in this precise subject and that it possibly isn't needed in all courses. Then the time the lecturer is given is quite limited and it is easy to prioritize other things I believe.	Lack of dedication Uninteresting topic Teachers (as a resource) Teacher (resources they are given)
81	Bias, too geared toward the forestry industry.	Biased concept in favour of industry
80	Lack of knowledge and comfort as well as that it will be costly to go from what you are used to to something new.	Lack of knowledge Economy
79	Not big enough cost incitement for increased efficiency and development within the sector	Lack of incentives for change Economy
78	-	
77	First and foremost that you have to learn to realize how important it is and not just take it for granted.	Lack of knowledge
76	Are according to me no obstacles. However the forestry master program is not very open for changes so therefore I believe that the best would be to intertwine the bioeconomy concept in as many courses as possible in the program.	No obstacles Conservatism (in program) Better educational planning
75	Old traditions Potentially lacking replacement options to existing options	Traditions
74	Lack of time, when other subjects are prioritized in the education and no thorough description of bioeconomy is covered.	Better educational planning Concept not used Concept unclear
72	Much focus on production in forest companies	Production focus

71	That you don't discuss it and advertise it so that people in society knows where it is.	Lack of societal connection Concept not used Lack of knowledge
70	Technology and budget	Technology Economy
69	That it is a relatively new concept with many unknown areas that are not completely developed or haven't been researched enough yet.	Concept unclear Lack of knowledge
68	Too conservative and much focus on traditional forest management	Conservatism Traditions
67	ambiguity in the concept	Concept unclear
66	Traditions of usage of fossile fuels	Traditions Fossile fuels
65	-	
64	Conservative people	Conservatism
63	The lack of forest Little knowledge	Lack of forest Lack of knowledge
62	Tardiness in wanting to change	Lack of dedication
61	That the forest sector is very traditional and not very innovative.	Traditions Lack of innovation
60	Possibly that there is too little knowledge about it	Lack of knowledge
59	No obstacle but maybe it is discussed too little at our education currently.	No obstacles Concept not used

		Better educational planning
58	-	
57	Ignorance	Ignorance
56	Ignorance, tradition, economy.	Ignorance
		Traditions
		Economy
55	Don't know	Don't know
54	Traditions in the forest industry and the forest industry's demand of education that suits the industry right now, not what the future forest management and industry might demand of the education	Traditions
		Better educational planning
		Industry influences education
53	Biologists that want that big parts of the productive forest area should be set aside from production. The states' derogation on the property rights. That big parts of society think that cutting down a tree is as damaging for the environment as pumping out 1000 litres of oil.	Anti-forestry people
		Too much regulation
		The production/environment divide
		Lack of societal connection
52	Older teachers that have it difficult to grasp new concepts and ways of thinking. The forest industry today influences how the education is conducted.	Teachers (as resource)
		Industry influences education
51	Ignorant teachers	Ignorance
		Teachers (as resource)
50	Don't know	Don't know

48	-	
47	Difficulty to communicate with the public about the benefit that the forest industry and other green industries actually have. More attention needs the public, politicians, special interest groups and business sector so that we can transition to a bioeconomy in an efficient way.	Lack of societal connection
44	Resources for development and understanding of the forest industry.	Lack of resources Lack of societal connection Poor understanding of the industry
43	-	
42	Don't see any immediate obstacles, also hard to form an opinion after only two semesters.	No obstacles
41	-	
39	Politicians, EU	Regulation (<i>either too much or too little, hard to guess</i>)
38	Interest and lack of knowledge	Lack of interest Lack of knowledge
37	That people in urban centers (big cities etc.) lack the understanding of how the forestry truly works in today's situation. Instead of e.g. seeing machines that destroy primeval forests, you should aim to give people the knowledge about the work that is put into keeping this from being realized, and also give them understanding of how amazing the forest actually is as raw material and what you can do with it.	Poor understanding of the industry Lack of societal connection Lack of knowledge
36	Aren't that many obstacles in the education, maybe more from society and bureaucracy with laws and regulations.	Bureaucracy Too much regulation

35	Misunderstandings between the environmental movement and the forest sector, from both ways.	The production/environment divide
34	Too little information about what it is	Lack of knowledge Concept not used
33	That the development is moving too fast so that teachers are unable to adapt the education.	Teachers (resources they are given)
32	Lack of teachers	Teachers (as resource)
30	That a lot of the focus is placed on decreasing the terrain damages instead on placing focus on development of machines with decreased soil pressure.	Lack of innovation <i>This is very difficult to sort/place somewhere</i>
29	-	
28	Traditional education as well as resistance against new competition in the different markets (politics and disinclination to break new ground)	Traditions Better educational planning Lack of dedication Lack of incentives for change
27	none	No obstacles
26	-	
25	That it is an uninteresting topic to many	Uninteresting topic
24	Costs and today's technology	Economy Technology
23	The educations are too traditional and lag behind in the technological advancement as well as new information.	Traditions Lack of knowledge

		Technology
		Better educational planning
22	Ignorance and bad spreading of knowledge about the topic. I am very interested in forests and study at the forestry bachelor program but have barely heard of bioeconomy.	Ignorance
		Lack of knowledge
		Concept not used
		Better educational planning
21	Society's view on Swedish forestry. Is viewed far too negatively and with the wrong angle.	Poor understanding of the industry
		Anti-forestry people
20	Difficulty with re-thinking in the program, the education is practiced as it always has been.	Lack of innovation
		Conservatism (in program)
		Better educational planning
18	Increase the consciousness of teachers and course literature.	Teachers (as resources and the resources they have)
17	OBS	
16	That no one really knows what it is and I don't think it helps with definitions at a high level but rather that you need to make it understandable at all levels and that all see where to strive toward so that it becomes the same direction.	Concept unclear
15	Complicated definition of the concept and too blurry future what it evolves into.	Concept unclear
14	Lobbyism and the resilience of the financially strong oil industry The low interest of forest educations	Lack of incentives for change
		Economy
		Fossil industry
		Better educational planning (to make it attractive to study forest)

13	An ambiguous definition of the concept that kind of implies a "more of everything" mentality, rather than real boundaries of what is possible or not	Concept unclear
12	Teachers that are not conversant in the biobased sector.	Teachers (as resource)
11	Don't know, does it have to be an obstacle? Potentially that it takes time to change the content of the education.	No obstacles Better educational planning
10	That the forestry sector sees it as an excuse to ignore nature conservation and put the production goal above the environmental goal in the future as well.	Production focus

Nya kodord :

The prod/env divide (anti-forestry people, production focus) $3 + 3 + 4 = 10$

Insufficient Education (Teachers as resources, their resources, better educational planning, industry influence) $7+3 +17+ 3= 30$

The Concept itself (Biased, unclear, not used) $1 + 7 + 8 = 16$

Conservatism (traditions) $6 + 11 = 17$

Climate change =1

Politics (Bureacracy, regulation too much or too little) $1 + 4 +3 = 8$

Ignorance (Lack of knowledge) $15 + 4 = 19$

Lack of Innovation (tech, fear of failure) $1 + 5 + 3 = 9$

Lack of Dedication ("people don't follow through",incentives for change,uninteresting) $6+ 5+4=15$

No obstacles

Land use planning (lack of resources, lack of forest) $2 + 1 +1 = 5$

Don't know (dont understand) $1+ 5 = 6$

Whole picture missing (other/bigger perspective, societal connection) $4 +6= 10$

Forest industry struggling (Economy, Fossile industry, poor understanding) $3+ 3+8=14$

Examensarbeten / Master Thesis
Inst. för skogsekonomi / Department of Forest Economics

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3. Wictorin, P. 2019. Skogsvårdsstöd – växande eller igenväxande skogar?
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11. Bernö, H. 2019. Educating for a sustainable future? - Perceptions of bioeconomy among forestry students in Sweden. *Utbildning för en hållbar framtid? - Svenska skogsstudenters uppfattningar av bioekonomi*